Rural Applications of Advanced Traveler Information Systems: Recommended Actions

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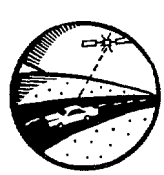

FOREWORD

The Recommended Action Plan is one in a series of interim documents for the Rural Applications of Advanced Traveler Information Systems (ATIS) project. Based on the investigation of user needs, a technology review, and concept development and assessment, the plan suggests a recommended direction for intelligent transportation system (ITS) deployment in rural and small urban areas (less than 50,000 population). Visions for deployment, developed by the project team, suggest a logical strategy that could be taken by FHWA, the public and the private sector to bring concepts from infancy to full deployment, These concepts fall into three categories defined through the user needs assessment: Emergency Response, Safety and Hazard Warning, and Traveler Services Information.

This document also identifies and evaluates 25 specific action items that could be initiated by FHWA to promote and develop rural ATIS. Research, prototype development, and field tests are identified within the three aforementioned project categories. For each potential project, the importance to the FHWA's ITS program plan, recommended action, desired outcomes, approximate cost, and participant responsibilities are identified. Based on these criteria, selected action items are recommended to be carried out, based on FHWA's priorities for each item.

The intended audience for this report is Federal, state, and local officials and others interested in and involved in the deployment of ATIS in rural and small urban areas.

A. George Ostensen
Director of Office of Safety and Operations
Research and Development

NOTICE

Technical Report Documentation Page

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16. Abstract

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This document also identifies and evaluates 25 specific action items that could be initiated by FHWA to promote and develop rural ATIS. Research, prototype development, and field tests are identified within the three aforementioned project categories. For each potential project, the importance to the FHWA's ITS program plan, recommended action, desired outcomes, approximate cost, and participant responsibilities are identified. Based on these criteria, selected action items are recommended to be carried out, based on FHWA's priorities for each item.

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METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)

1 foot (ft) = 30 centimeters (cm)

1 yard (yd ▫ 0.9 meter (m)

1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2 = 6.5 square centimeters (cm^2)

1 square foot (sq ft, ft^2 = 0.09 square meter (m^2)

1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)

1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)

1 acre = 0.4 hectares (he) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gr)

1 pound (lb) = .45 kilogram (kg)

1 short ton = 2,000 pounds (Lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)

1 tablespoon (tbsp ▫ 15 milliliters (ml)

1 fluid ounce (fl oz) = 30 milliliters (ml)

1 cup (c) = 0.24 liter (l)

1 pint (pt) = 0.47 liter (l)

1 quart (qt) = 0.96 liter (l)

1 gallon (gal) = 3.8 liters (l)

1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)

1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] ^oF ▫ y ^oC

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)

1 centimeter (cm) = 0.4 inch (in)

1 meter (m) = 3.3 feet (ft)

1 meter (m) = 1.1 yards (yd)

1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)

1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)

1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)

1 hectare (he) = 10,000 square meters (m^2) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gr) = 0.036 ounce (oz)

1 kilogram (kg) = 2.2 pounds (lb)

1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

VOLUME (APPROXIMATE)

1 milliliters (ml) ▫ 0.03 fluid ounce (fl oz)

1 liter (1) = 2.1 pints (pt)

1 liter (l) = 1.06 quarts (qt)

1 liter (l) = 0.26 gallon (gal)

1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)

1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

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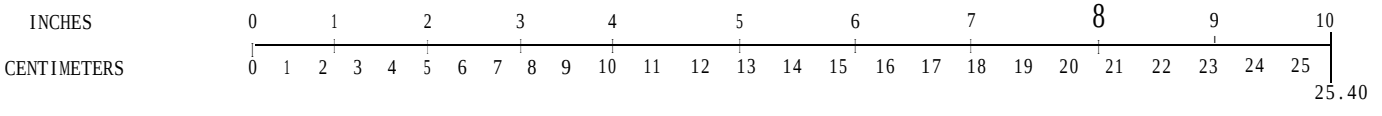
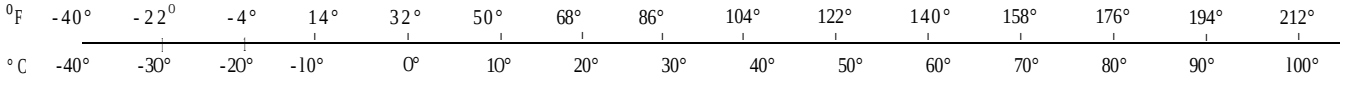
QUICK INCH-CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT-CELSIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NBS Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10286.

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CHAPTER 1. INTRODUCTION

OVERVIEW

In 1993 the Federal Highway Administration (FHWA) began a research project to find ways to improve safety, mobility, and services in rural areas. This project is entitled "Rural Applications of Advanced Traveler Information Systems (ATIS)." The project's objectives are to provide recommended direction for Federal programs with respect to intelligent transportation system (ITS) technologies in rural and small urban areas and to provide guidelines for ATIS implementation efforts by State and local government agencies in meeting rural travelers needs.

Based on project findings to date, it is recommended that FHWA's rural ATIS activities focus on three major areas:

- Emergency Response.
- Safety and Hazard Warning.
- Traveler Services Information.

This report summarizes project findings to date and documents recommended actions for each of these focus areas. These recommendations fall into three basic categories of action:

- Field Test.
- Prototyping.
- Research.

A summary of the recommended actions is shown in figure 1.

RURAL ENVIRONMENT

The rural environment encompasses rural and small urban areas with populations less than 50,000. Eighty-five percent of the road mileage in the United States is in rural and small urban areas. On the order of 1,400 billion vehicle kilometers (900 billion vehicle-miles) of travel occur annually in rural areas, and about one-half billion auto trips are made each year in rural areas of the United States by local rural residents and intercity and interstate travelers. Traffic fatalities are disproportionally represented in the rural environment. Whereas 40 percent of the vehicle-kilometers of travel in the United States is on rural roads, 61 percent of all fatal accidents occur on rural roads.

The rural environment is set apart by the several distinguishing features:

- Trip distances are relatively long.
- Volumes are relatively low.
- Congestion is relatively rare, and the times and locations vary; however, the impact may be more severe.
- Alternate routes are few.
- Many travelers are unfamiliar with the surroundings.
- Highways may traverse rugged terrain in remote areas.
- Effect of climatic conditions can be extreme.
- Animals wandering onto or bounding across roadways present unique hazards.

FOCUS AREA	RESEARCH	PROTOTYPE	FIELD TEST
EMERGENCY RESPONSE	• Conduct market research on mayday systems in conjunction with the private sector (auto manufacturers) • Develop mayday communications standards (e.g., message length and content, capacity, transmission time) • Identify needs of mayday response centers (e.g., staffing, software, compatibility) • Develop standards for in-vehicle units (e.g., size, power, antenna)		• Comparative analysis of communications (LEO and GEO) for mayday application - transmission delay - coverage - content limitations
SAFETY AND HAZARD WARNING	• Research existing roadside to vehicle communications systems: - directionality - message capacity - coverage • Perform user acceptance on marketability and usefulness of in-vehicle safety and warning systems • Feasibility of vehicle probes for roving environmental data collection • Research animal response to audio stimuli • Establish standards for short range communications (for roadside to/from vehicle and vehicle-to-vehicle communications) • Research human factors and operational requirements related to in-vehicle safety and hazard warning system	• Develop and test a prototype electronic flare warning system, test for accuracy, trans. range, directionality: - radio signal - code from transmitter to activate specific message - transmission of actual message • Equip a probe vehicle (police or maintenance vehicle) with sensors for weather and road condition monitoring and transmitting of info to roadside • Test of active AVI for delay measurement (with transmission to portable CMS)	• Measurement and transmission of real-time delay information to a portable CMS at a work zone: - manual - radar (spot spd.) - passive AVI • Demonstration of a dynamic roadside speed warning system at a sharp curve (2-lane road) • Demonstration of an in-vehicle safe speed warning system using head-up display • Demonstration of a dynamic variable speed limit signing system

Figure 1: Rural ATIS Action Plan Summary

FOCUS AREA	RESEARCH AND DEVELOPMENT	PROTOTYPE	FIELD TEST
TRAVELER SERVICES INFORMATION	• Research and test of transmission capacity of roadside beacons for traveler information • Identify and develop potential opportunities for public/private partnerships for funding and operation of regional traveler information centers		• Development and field test of a pre-programmed read-only portable travel information system • Field test of a kiosk with automated service provider update capability. Contains integrated traveler information, routing, weather info. Cooperative venture with existing TIC • Demonstration of active logo signing system with multiple business participants
GENERAL	• Develop an effective outreach program to educate rural stakeholders and to generate a grass roots constituency for ITS in rural and small urban areas • Research ways to overcome institutional barriers (funding, jurisdictional authorities) for implementation of rural ATIS		

Figure 1: Rural ATIS Action Plan Summary (Continued)

WHY RURAL ATIS?

To date, ITS applications have been primarily focused on metropolitan areas. However, restricting ITS applications to urban and metropolitan areas would undermine, for example, the ability of technology to reduce a large number of accidents, which occur in rural areas of the United States. There is considerable justification for implementing rural ITS applications, particularity in the area of advanced traveler information systems.

Rural ATIS combines the application of electronic and communication technologies with creative concepts to improve safety, mobility, and services for travelers using transportation systems in rural areas. Examples of these potential ITS applications abound. The number and severity of accidents may be reduced through use of advanced technologies. On-board hazard warning and crash avoidance systems may to some degree reduce occurrences of fatalities in rural areas arising from single vehicle accidents involving inattentive or dozing drivers. Similarly, devices outside the vehicle may supplement drivers' vigilance and control and subsequently enhance driver safety.

ITS technologies can markedly improve mobility of rural travelers. Non-recurrent congestion can cause major problems on rural roadways. The vast majority of rural roads are two-lane, increasing the likelihood of a closed travel way in the event of an in-lane incident. ITS technologies can be enabling platforms to update maps and provide up-to-date incident and construction information and necessary route changes. Technologies such as head-up displays of route information (i.e., safe speed for the condition), in-vehicle signing in both public and private vehicles, two-way communication, and vehicle systems monitoring are some other examples of ITS applications which could enhance and perhaps extend traveler mobility beyond what is possible today.

ITS technologies can also facilitate traveler services such as trip planning, route guidance, and traveler advisory information in a more efficient and effective manner. Advanced surveillance, detection, and communication technologies could provide ITS services to drivers, whether they are familiar or unfamiliar with their surroundings. Route planning services provided in advance of trips may help travelers to make decisions regarding mode of travel, routing, and departure time. Traveler advisory information could be sent directly to in-vehicle route guidance systems. Enhanced communication and vehicle location capabilities may improve rural emergency response times as well as improve the quality of rural public transportation services in rural communities and areas.

Developing functional and useful rural ATIS designs requires an understanding of the needs of those who will use such systems, as well as of the environment in which these systems will be placed. The next chapter probes rural traveler information needs as the first step toward gaining these requisite understandings.

ACTION PLAN DEVELOPMENT APPROACH

In order to develop action items, it was imperative to first determine user needs and develop applications which meet those needs. The following steps, also illustrated in figure 2, were taken in the process of developing action items:

- User Needs Assessment - Conduct a comprehensive assessment of user needs. Evaluate the significance of rural travel needs as a means of substantiating the user needs.

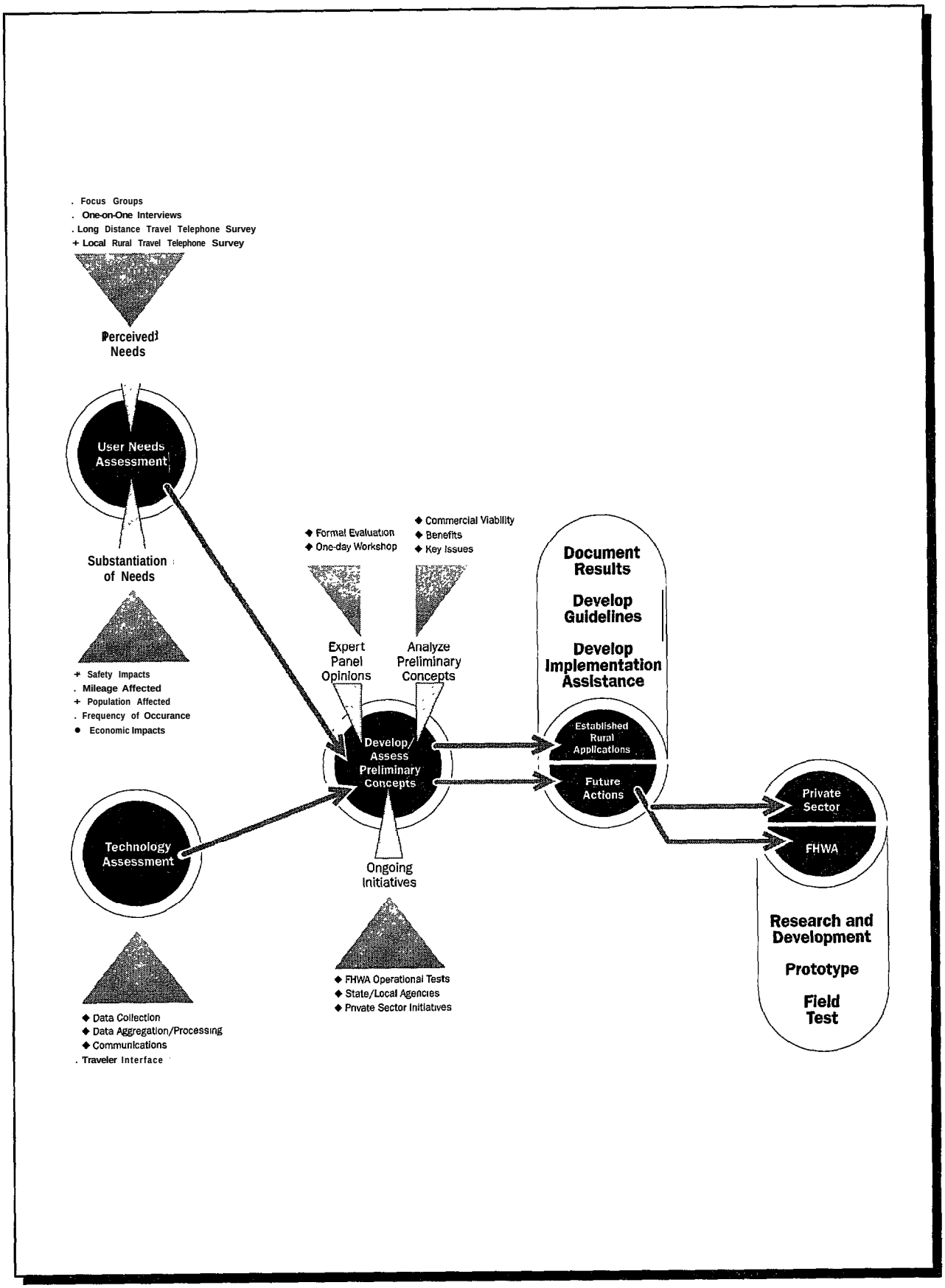

Figure 2: Rural ATIS Action Plan Development Process

Technology Review - Perform a review of relevant technology both in existence and under development. Determine each technology's potential applicability to a rural ATIS.

- Concept Development/Assessment - Develop and assess a range of rural ATIS concepts which address substantiated user needs and take advantage of applicable existing and emerging technologies.

- Recommendations - Identify future rural ATIS initiatives in which FHWA could play a critical and important role.

The User Needs Assessment, Technology Review, and Concept Development and Assessment are the subject of chapter 2 of this report. Recommendations are covered in chapters 3 and 4.

CHAPTER 2. MAJOR FINDINGS

This chapter presents major findings of the user needs assessment, the technology review, and concept development and assessment activities.

USER NEEDS IN RURAL AREAS

Development of a rural ATIS action plan requires an in depth understanding of traveler information needs in rural and small urban areas and how ATIS applications might meet these needs. Accordingly, an assessment of user needs, both as perceived by rural roadway users and as substantiated by statistics, has been conducted. Two national surveys were performed in both rural and urban areas to elicit rural travel information priorities from respondents. Focus group sessions were also used as an exploratory research technique to identify the information needs and priorities of general travelers, with people being visited at nine locations throughout the United States. In all, 31 focus groups, 61 one-on-one interviews, and 1025 telephone interviews were completed with various individuals and groups from around the country. Detailed findings of the user needs assessment are documented in the project's User Needs and Technology Assessment Report.[1] The following user needs and concerns summarize those findings:

- The availability and usefulness of an in-vehicle distress signal.
- Information concerning approaching hazards within the next mile or so.
- Availability and usefulness of an in-vehicle system to activate an alarm if the driver falls asleep at the wheel or the vehicle starts to go off the road.
- Information concerning road closures and traffic congestion ahead.
- Information warning a driver of maximum safe speed under prevailing conditions, such as rain or construction.
- Pre-trip planning information concerning directions and route selection to get to the destination.
- Information about road and weather conditions, provided en route in order to take into consideration the possibility of rapidly changing conditions (important for fleet operators, CVO, and emergency medical services).
- Mayday system abuse, false alarms, system expense, and availability of resources to monitor the signals are concerns of emergency service providers.
- Information providers identified barriers to ATIS implementation: funding, user sensitivity to the cost of in-vehicle systems, liability with respect to the accuracy of information and performance of systems, and the standardization of technologies and communication.

Perceived user needs were substantiated (or refuted) using various data sources, including accident statistics, traveler information requests, roadway service flow ratios, and operational tests of urban ATIS.

The weighted relative priority of user information needs, based on both substantiated and perceived needs, is shown in figure 3[1]

TECHNOLOGY REVIEW

An extensive investigation was conducted to identify technologies that are likely to support rural ATIS applications. The results of the technology assessment can be found in the State of the Art Technology Report.[2] Several major conclusions were drawn from this investigation:

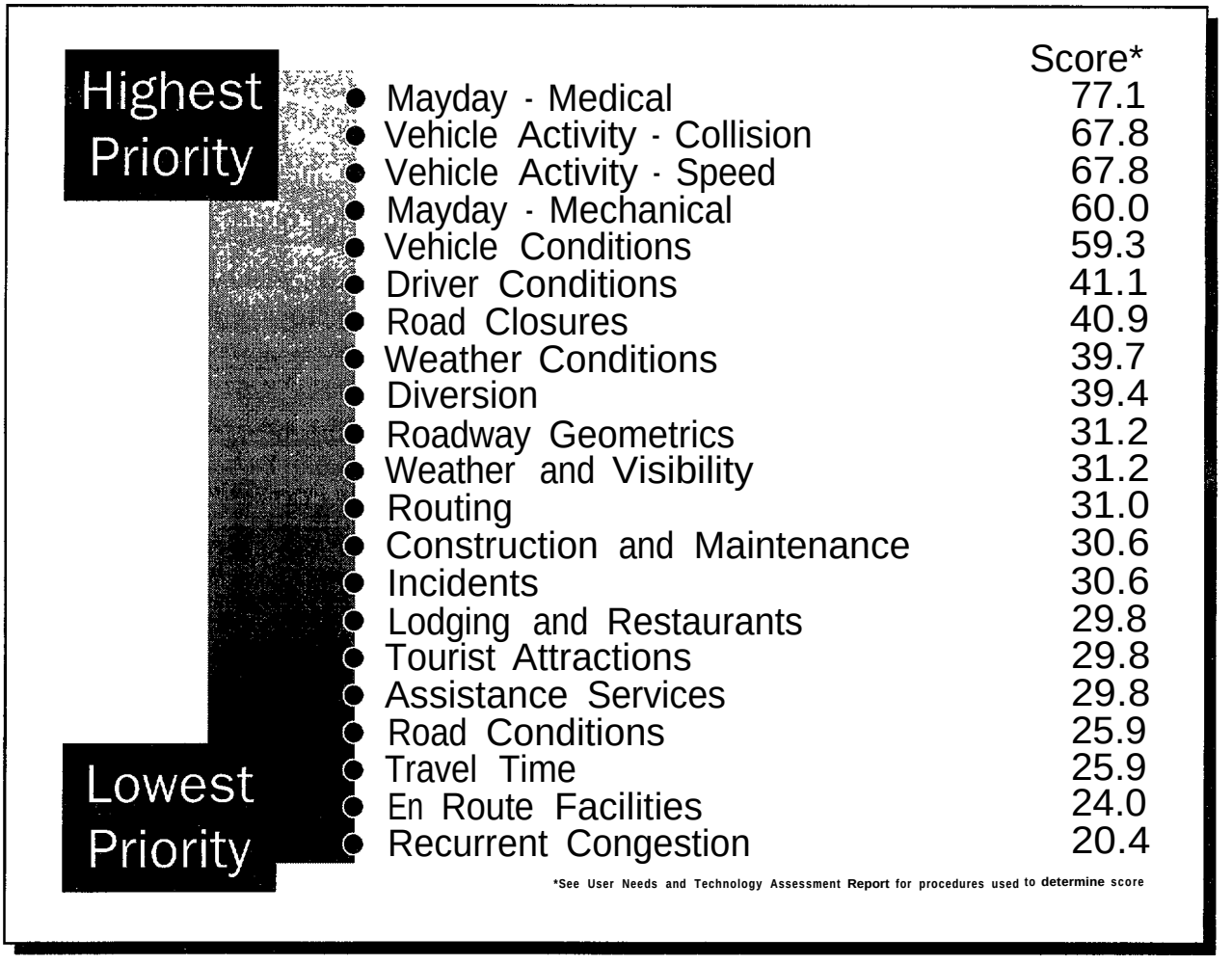

Figure 3: Relative Priority of Information

- Substantial proven technology is available to support basic rural ATIS applications.
- Significant potential for piggybacking rural ATIS applications on other, non-transportation related investments exists.
- Infrastructure costs and the nature of user priorities make in-vehicle and targeted roadside systems a high priority.
- Communication is a major challenge.
- Non-safety/non-emergency applications must be commercially viable.
- Legal liability is a key concern.

CONCEPT DEVELOPMENT/ASSESSMENT

A series of preliminary concepts was developed in response to the user needs. These concepts and the user needs they fulfill are shown in figure 4, and a short description of each concept can be found in appendix A.

Each concept was analyzed in detail. The results of this analysis are documented in the project's Preliminary Concepts Working Paper.[3] The concepts were evaluated based on the following factors:

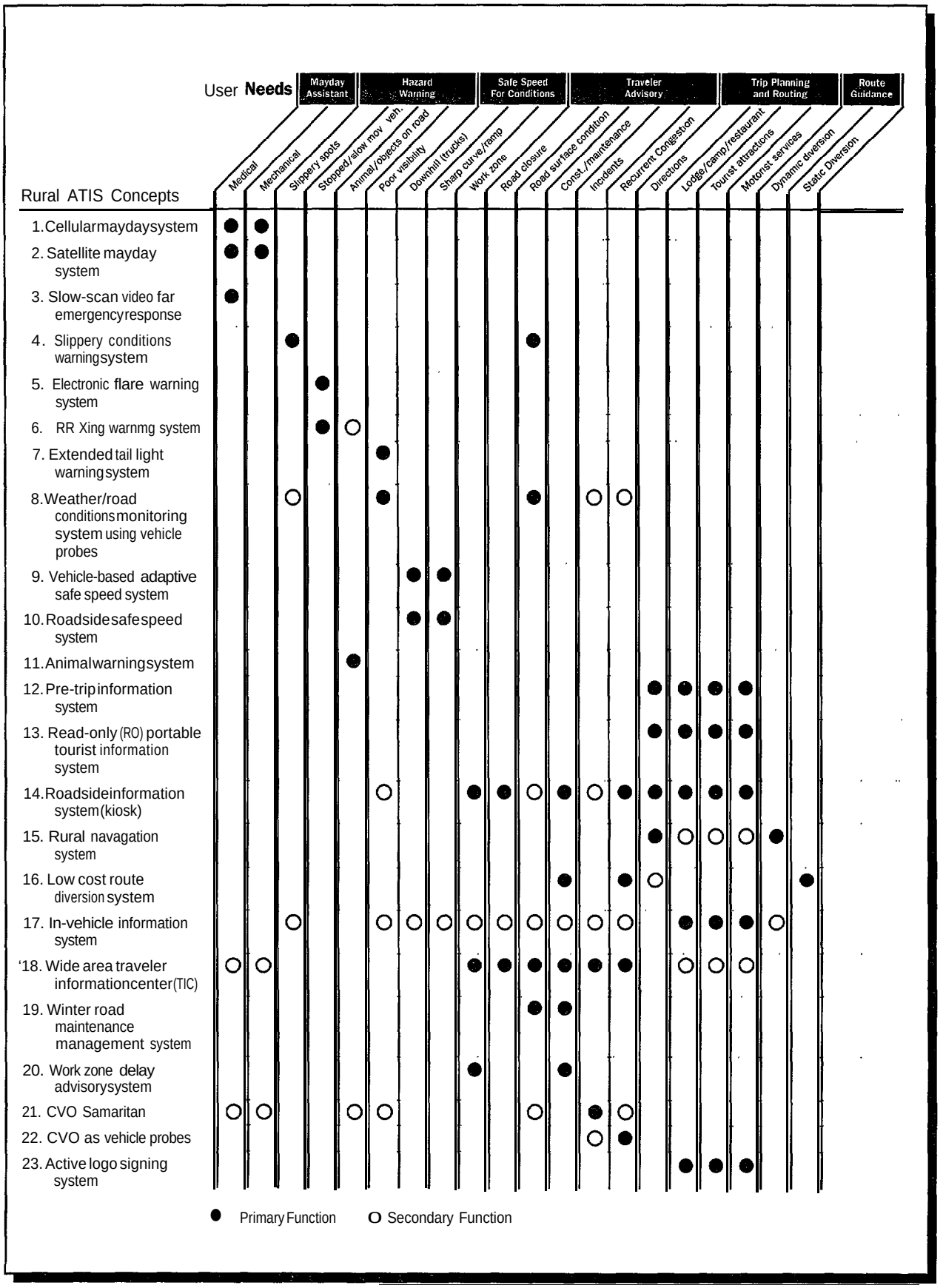

Figure 4: Preliminary Concepts vs User Needs

- Commercial viability.
- Related projects or products.
- Benefits.

Major issues associated with each concept were defined and discussed in several categories:

- Effectiveness in meeting user needs.
- Standardization requirements.
- Deployment.
- Technical complexity.
- cost.
- Liability.

A meeting was held with the project Expert Panel, a group of professionals hand picked to help guide the activities and direction of the project. This meeting served as a forum for candid and detailed discussion of each concept, its strengths and weaknesses, its likelihood of success, and its implementation possibilities. As a result, the panel came to three major conclusions:

- Project resources should be focused on concepts which are not already evolving through private sector actions or existing public/private initiatives.
- Safety and emergency response in rural areas is the area of primary concern.
- Emphasis should be placed on collection and synthesis of traveler information, designed to provide a common access point for information on hazardous weather conditions, traveler services, recommended routing, congestion, and related issues on a regional basis.

As the results of the preliminary concept assessment, several of the most promising concepts were identified for further analysis. This analysis included discussions of institutional, legal, and technical issues, requirement analysis, strategic architecture, and potential benefits of each concept. The results of this analysis are documented in the project's System Analysis Report.[4] Based on the results of the system analysis activities, a series of recommendations have been identified and are presented in the following chapters.

CHAPTER 3. A VISION FOR RURAL ATIS DEPLOYMENT

This report is targeted specifically to the actions that FHWA can take in the development of the rural ATIS program. It is important to understand, however, that deployment of ATIS technologies in rural areas involves the actions of many other public agencies and private sector partners. FHWA is not directly responsible for ITS deployment but serves as a catalyst for implementation by others. The roles of FHWA related to rural ATIS generally include:

- Sponsoring critical research that others would be unwilling to undertake on their own, due to high risk or other factors.
- Serving as a clearinghouse of information on ITS applications.
- Providing seed money for the development and testing of promising technologies.
- Coordinating the development of standards and guidelines that will result in implementation of the most cost-effective ITS applications.
- Encouraging the application of proven ITS technologies and experimentation with emerging and new technologies for improving mobility and increasing safety and system efficiency.

The recommended actions developed for this project directly address only the activities of FHWA related to rural ATIS. However, it is critical that the creation of the recommended actions occurs within the context of an overall vision of deployment or "big picture." A failure to do so may result in research activities that do not significantly contribute to deployment. Taking this approach recognizes that successful deployment is a partnership. There is a place for FHWA in that partnership as well as for the private sector and other government agencies. These responsibilities should be defined and understood for effective and timely implementation.

Some of the questions that need to be asked as part of the "big picture" include:

- How will the technology ultimately be deployed?
- What barriers need to be overcome that stand in the way of deployment?
- How will deployment be funded?
- Who will be responsible for the various elements of deployment?
- How will those deploying and operating the technology be trained?
- How will operation and maintenance be funded?
- How will those operating and maintaining the system be trained?

As part of the development of the FHWA program for its own involvement in rural ATIS, a series of "road maps" was established for overall deployment of rural ATIS strategies. This was done to ensure that FHWA research fits logically into the overall context. The next several sections describe these road maps to implementation. The road maps are founded on several fundamental principles:

- Deployment should seek to minimize government involvement (i.e., should encourage the private sector to take on as much responsibility as possible).
- Deployment of rural ATIS elements on the public right-of-way will require direct government involvement.
- The market for purchase of ATIS technologies is able to determine of which ATIS technologies are perceived by the traveler to be cost-effective.
- FHWA involvement is important in the early stages to resolve technical and human factors issues and to coordinate standards and guidelines.

The road maps do not cover all possible applications of rural ATIS. Rather, they focus on those applications found to be most promising and for which FHWA involvement is believed to be needed. Other rural ATIS applications may occur that are not presented as part of this overall vision.

The vision for rural ATIS is presented using the three major focus areas identified earlier: emergency response, safety and hazard warning, and traveler services information. In all three areas, ultimate deployment is viewed to be primarily dependent on the private sector. This differs from the historically high level of involvement by the public sector (i.e., State and local governments) in other ITS areas such as advanced traffic management systems (ATMS).

EMERGENCY RESPONSE

The most important user need, as borne out by the traveler surveys, is for communication in emergency situations. By definition, rural travel is in areas with sparse population, infrequent cities and towns, and lighter traffic volumes than in urban areas. Statistics indicate that in rural areas, compared to urban areas, fatal accident rates are higher and emergency vehicle response time is longer. Travelers also perceive that they are more isolated in a rural environment. These facts and feelings lead to this user need: travelers want to be able to summon help when needed, regardless of their location.

Figure 5 illustrates a possible road map to deployment of mayday systems. The figure uses several shapes to indicate elements of mayday implementation. A rectangle represents a proposed public sector activity. A double rectangle indicates an activity proposed for FHWA (e.g., original research or prototyping and field testing). An ellipse represents an activity of the private sector. A diamond indicates an activity of FHWA that is currently underway.

It is highly unlikely that a large government program will be created to equip and staff mayday response centers. Rather, the private sector will likely need to take responsibility for mayday call screening and for passing along legitimate emergency requests to the appropriate emergency response units.

There is a strong parallel between the private sector approach to mayday systems suggested in figure 5 and the current proliferation of private security systems. Security agencies screen triggered alarm calls and pass along legitimate calls to authorities. It is a service for which many consumers are willing to pay. Thus, the essence of the long-term deployment consists of the establishment of private sector response centers and the development and marketing of in-vehicle mayday units. Coordination must take place with public sector emergency response centers (typically 911 services).

A mayday deployment plan will be needed to guide implementation. The plan will likely be developed internally by those companies wishing to establish mayday services, but the plan will need to be carefully coordinated with public sector emergency services.

While the development of mayday services could proceed today without the involvement of FHWA, there are several activities that could be performed under FHWA sponsorship that would ensure that the best information is available on which to base deployment decisions. The principal area of FHWA involvement is in researching the optimum communication links for mayday deployment in rural and small urban settings. Satellite and cellular communication links are being expanded at a rapid pace, and the right communication link for each geographic area, terrain, etc. is unclear. Claims are also being made by providers for communication delay time, cost, and other factors. These questions need to be researched to protect the interests and safety of the public. This research effort is proposed as an

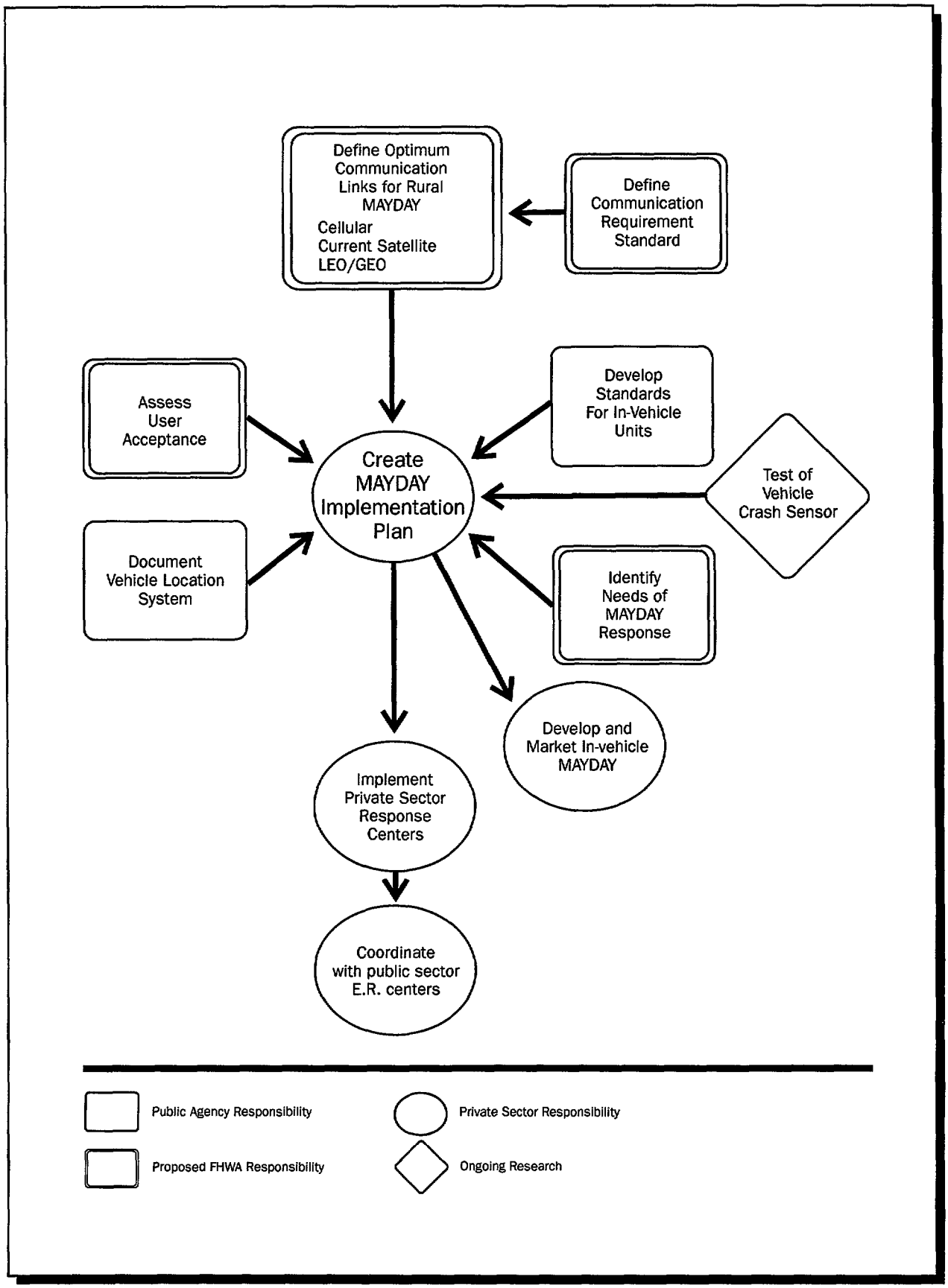

Figure 5: Road Map to Deployment of Mayday Systems

area of involvement of FHWA in stimulating cost-effective mayday applications. The research will feed the development of the mayday deployment plan.

A second area of involvement proposed for FHWA is measuring user acceptance for mayday systems. This will provide the private sector with a sense of the types and extent of services that could be marketable, saving duplicative efforts of many independent market analyses. A third area of involvement by FHWA shown in figure 5 includes identifying the needs of mayday response centers. This would involve a review of equipment and personnel requirements, again to stimulate interest on behalf of the private sector.

It is possible that the private sector will find mayday systems not to be profitable as a line of business. On the other hand, the sale and operation of mayday systems could spawn a large enterprise such as has occurred in the security industry. If mayday systems are not established by the private sector or are established on a very limited scale, the public sector will need to make a determination as to whether the public interest is well-served by instituting such services, given the various demands on government finances. This determination will need to be made by the appropriate government officials.

SAFETY AND HAZARD WARNING

Safety and hazard warning improvements are needed mostly to provide real-time information to the traveler on road sections with increased accident risk. Such risks may be caused by roadway geometry, bad weather conditions and their impact on the driving conditions, animals on the roadway, construction and maintenance activities, or risky driver/vehicle behavior for the prevailing conditions. School buses and slow moving vehicles may also pose particular hazards in rural settings. A variety of safety and warning systems can potentially contribute to both traveler safety and convenience. Warning of hazards ahead, appropriate speed for the conditions, and imminent collision may substantially reduce the accident risk in rural areas.

There are three principal areas where research activities are proposed for safety and hazard warning: work zone delay advisory system (an expansion of current research), electronic flare warning system, and roadside safety warning system. Approaches to the deployment of these technologies, and FHWA research to support deployment, are described below.

Work Zone Delay Advisory System

Current research and field testing is underway on a work zone safety system. This work involves development and evaluation of a portable, dynamic work zone traffic control system to address the problem of construction work zone safety. However, there are several options for work zone advisory systems that may be appropriate under a range of conditions. Alternative systems could include passive AVI, active AVI, and spot speed measurement systems (e.g., radar to determine work zone delay). Examples of the factors that may influence choice of system include:

- Presence of Trucks with AVI Tags - The number of trucks with AVI tags is growing rapidly. A sufficient number on the roadway in the next several years will make an active AVI system more feasible and considerably less expensive than some alternatives.
- Traffic Volume - Higher volume could warrant a more sophisticated system.
- Duration of Construction Period - A longer construction period could allow for a more comprehensive or sophisticated installation.

Figure 6 indicates the road map to implementation of work zone delay advisory systems. The bottom element in the chart indicates the primary way in which these systems will find their way into common application: specification for their use in construction contracts. This will be a public agency decision based on application criteria generated as part of the research program (e.g., minimum volume levels, construction period, delay levels expected). However, the systems will be developed and marketed by the private sector. This process is virtually identical to the way in which arrow boards and portable changeable message signs have been brought into common use in construction. In fact, many applications of work zone delay advisory systems would use portable changeable message signs that would have been procured even without the delay advisory component. In this case, the detection and delay estimation elements would be added, along with the ability of the sign to accept real-time inputs.

Expanded field testing on work zone delay advisory systems is needed to ensure that the most effective, economical systems become available to meet the range of applications. Successful deployment will ultimately depend on the private sector being able to develop low-cost, easily-used systems and the contracting agencies (State and local governments) finding applications that are deemed to be worthwhile.

The expanded field testing should particularly include an examination of active AVI systems. This could be accomplished on corridors where AVI systems are in place, such as on toll roads. The road map to implementation should also include the development of standards (governing the equipment and communications methods), application criteria (where installation may be appropriate), model contract specifications (to assist agencies in procurement and the private sector in design), and installation/operation guidelines (joint activity of the public and private sector).

Electronic Flare Warning Systems

Figure 7 shows the road map for deployment of electronic flare warning systems. These systems will be implemented principally by the private sector but with procurement of the devices by some public agency fleets. In addition, public agencies may procure transmitters for application at certain hazardous locations, such as blind driveways, unexpected curves, and rural construction sites. The concept can be extended more broadly to electronic signs in general, serving as an additional warning (not replacement) for certain types of warning signs and even regulatory signs (e.g., speed limits approaching a small town, to reinforce advance signs such as “Stop Ahead” signs). Displays can include either audible warnings or messages on head-up displays.

There is an important role for FHWA in further research and field testing that sets the stage for deployment, even though deployment will be largely private sector driven. Vehicles will soon be on the market with the capability of displaying electronically received messages. An appropriate FHWA role will be to work with the private sector to field test systems in a variety of applications, to conduct market research for both receivers and transmitters, and to promote development of standards that would govern their deployment. Liability issues must be resolved before these systems are likely to receive widespread implementation. Some of these issues include:

- Lack of transmission of an alert at the appropriate time.
- Potential for false alarms caused by indiscriminate warning signal transmission.
- Improper operation of the system.

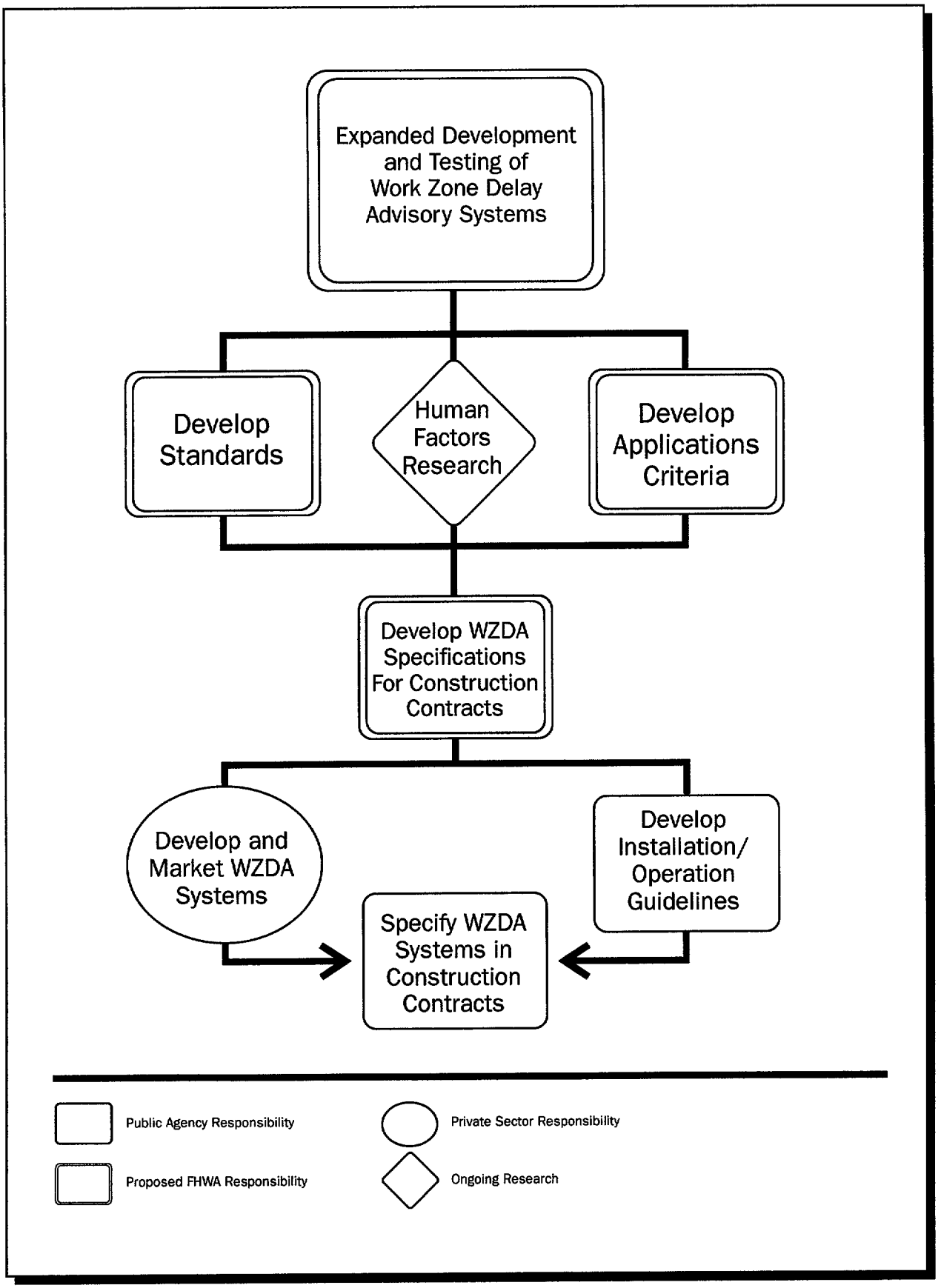

Figure 6: Road Map to Deployment of Work Zone Delay Advisory System

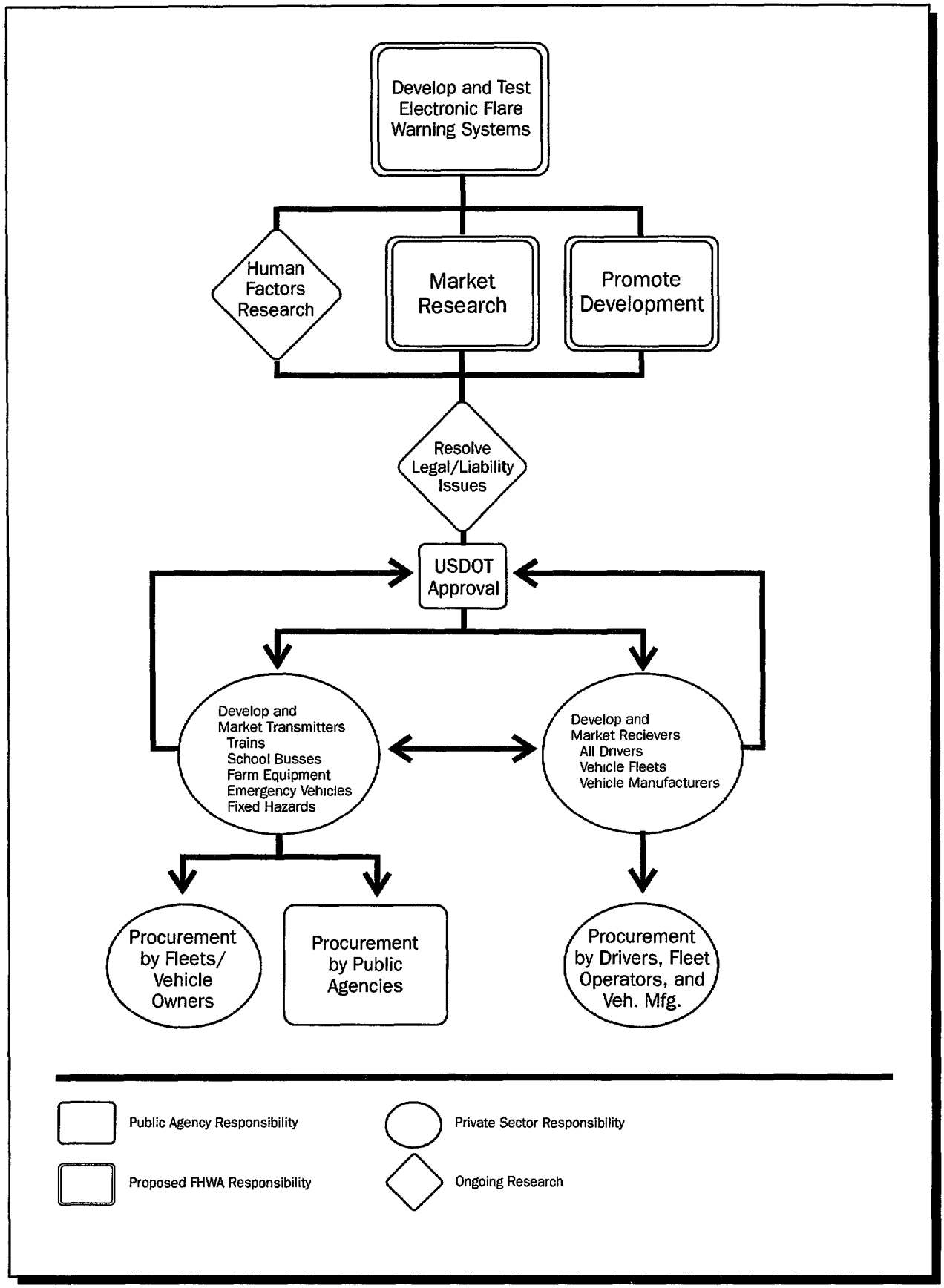

Figure 7: Road Map to Deployment of Electronic Flare Warning Systems

Roadside Safe Speed Warning System and Variable Speed Limit Signing

As shown in figure 8, there are three classes of products that are related to roadside safe speed warning systems and variable speed limit signing: in-vehicle receivers capable of accepting transmitted messages, active display systems that can show variable speeds on roadside signs, and roadside processors and detectors that collect data on road and weather conditions and vehicle characteristics and compute the safe speed or speed limit. The in-vehicle receivers will be procured by drivers, fleet operators, and vehicle manufacturers. The other two products will be procured and installed by public agencies based **on** application criteria.

The difference between the safe speed warning element and the variable speed limit element of the concept is basically regulatory versus non-regulatory; variable speed limit signing is regulatory. The same condition information and processing can be integrated under both elements. It may also extend over a longer section of roadway (e.g., as is now being done on Snoqualamie Pass in Washington State during snow storms, fog). The safe speed warning system is also expected to focus primarily on trucks and in specific geometric conditions. In both the variable speed limit and safe speed warning systems, weather is an important element.

As with electronic flares, an appropriate FHWA role will be to work with the private sector to field test systems in a variety of applications, to conduct user acceptance research for in-vehicle receivers, and to promote development of standards that would govern their deployment. Liability issues involved in dissemination of incorrect safe speed to travelers must also be resolved.

TRAVELER SERVICES INFORMATION

A third category of information requested by travelers is information about available services: lodging, restaurants, automobile service, and points of interest. Although this data is not as critical to traveler safety, it is quite important for traveler convenience and peace of mind. Traveler services information can also aid in the economic development of rural areas. This is a user need that can likely be supported by the private sector. Travelers indicated that they are more willing to pay for this "convenience" type information.

Several concepts have been combined in figure 9 to illustrate the road map to deployment for traveler services information. Deployment will be principally a private sector undertaking, driven by the desire of service providers to advertise their services. The primary components of deployment are:

- Information Broker - Companies or individuals who identify those who wish to make their services known and who identify outlets for that information. Billboard companies are a current form of information broker. Another example of an information broker is GeorgiaNet, a quasi-public agency coordinating the assembly and distribution of information at 130 kiosks in Georgia.

- Information Outlets - The locations where information could be obtained. These locations could include State welcome centers (often in rural areas at State lines), truck stops, auto clubs, service stations, tourist attractions, and recreational areas. An outlet could also include a roadside transmission station that "dumps" information to an in-vehicle system pertaining to services at an upcoming rural Interstate interchange or along a two-lane road approaching a small town.

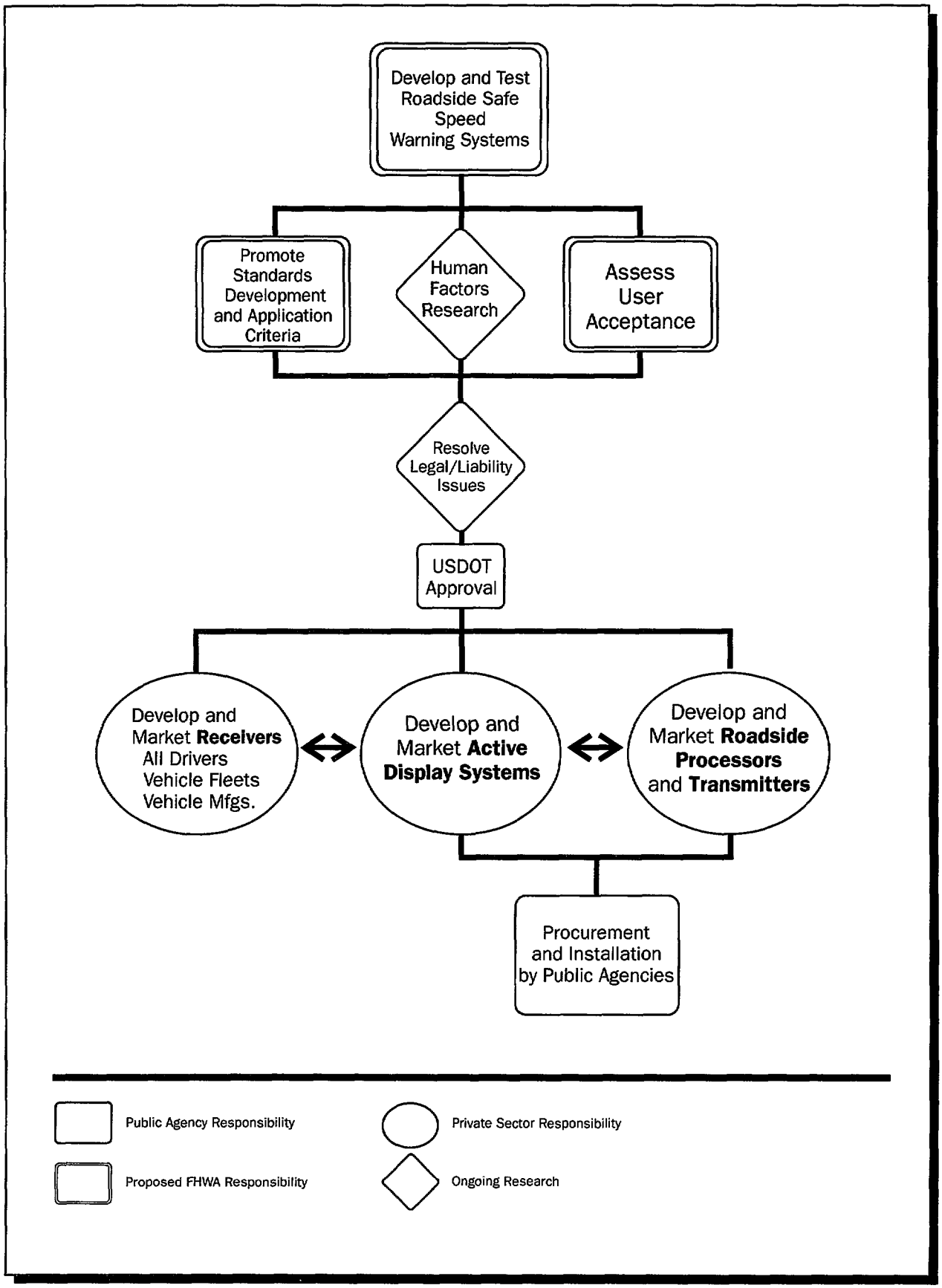

Figure 8: Road Map to Deployment of Roadside Safe Speed Systems

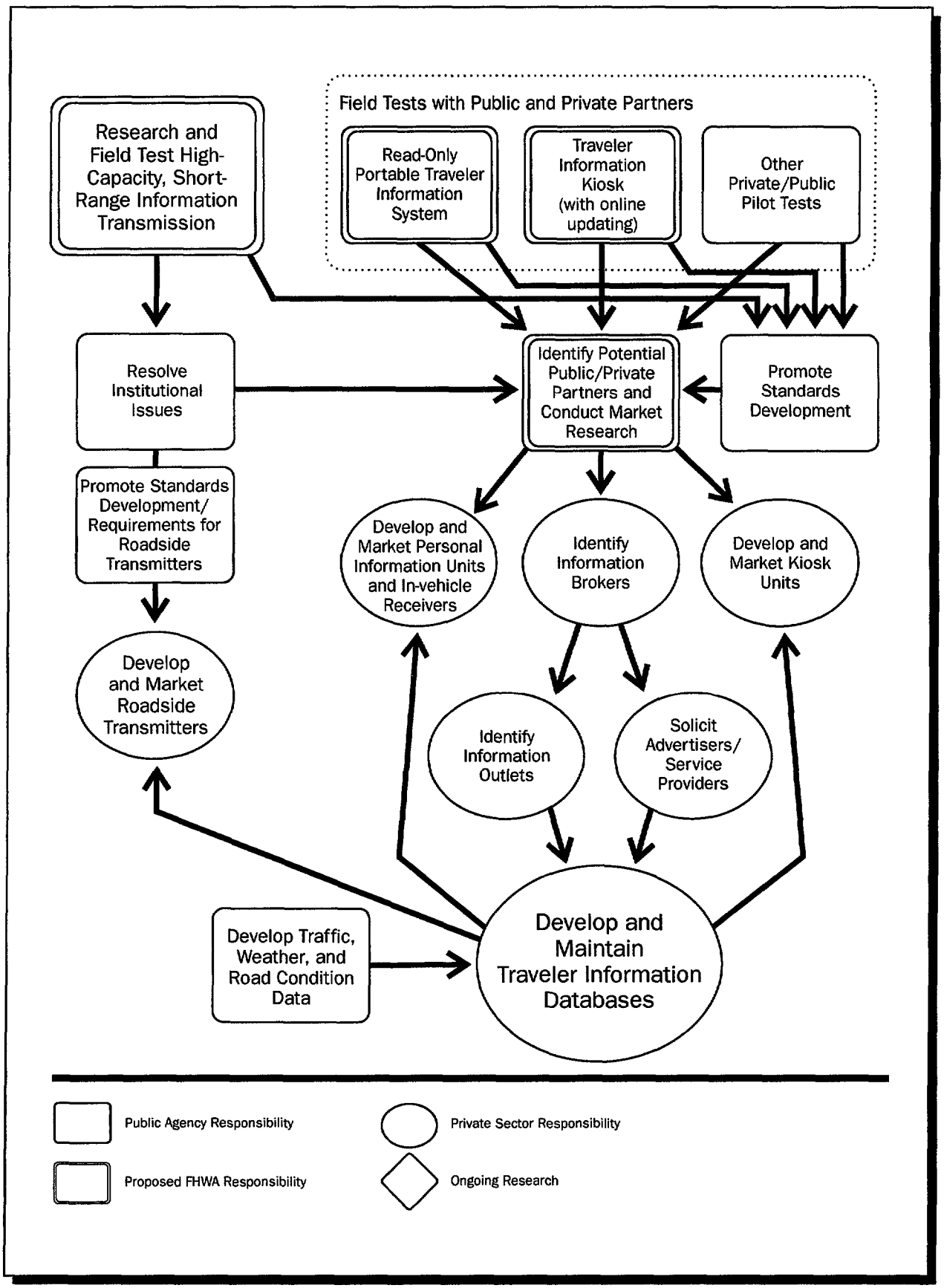

Figure 9: Road Map to Deployment of Traveler Services Information Systems

Advertisers and Service Providers - Those who need to make their services known, particularly to motorists unfamiliar with the area. Information could include standard information about location and nature of services but could also include information on prices, sales and specials.

Development and Maintenance of the Services Data Base - This would include inputs from the public sector, where appropriate, on traffic information, weather, and road conditions, The data base could be maintained by the information broker or other entity.

Products developed by the private sector to serve as the user interfaces to convey or transmit the information to the traveler. There are three specific products identified in figure 9.

Personal Information Units - Hand-held data storage and display units to which the most current information could be physically downloaded directly from the information source or via modem to the information source. These units could be rented or purchased by the traveler.

In-Vehicle Receivers - Devices that can receive information (e.g., information on services at the next interchange) from a roadside transmission station. These devices could also be rented (e.g., at a State welcome center for use while in the State) or purchased.

Roadside Transmitters - These would transmit bursts of information to passing vehicles equipped with compatible receivers. One of the legal hurdles of the application of the transmitters is whether they can be located on the public right-of-way. If the transmitters can be located on private property, this does not become an issue.

Kiosks - Units that can be updated frequently through dial-up access to the central data base. Kiosks are now being deployed with regularity. However, advertisers and service providers may wish to update their information frequently (e.g., on a daily basis) and may wish to do it directly themselves. The field test envisioned for kiosks would incorporate this on-line updating feature.

The reason the deployment of traveler services information systems are viewed to be primarily private sector undertakings is that the public is unlikely to pay merely for traffic, weather, and road condition data in rural areas. However, a large market exists for services information in rural areas, as evidenced by the existence of billboards, over a $1 billion industry.

There are several important roles for FHWA:

- Field test the read-only traveler information system (i.e., using personal information units).
- Field test information kiosks, particularly the on-line updating feature.
- Research and field test high-capacity, short-range information transmission to set the stage for deployment of the roadside transmitters and in-vehicle receivers. This is the area where the most research is needed, with emphasis on increasing the amount of information that can be transmitted to a moving vehicle. It also has the potential for being the most difficult institutional issue

to resolve (i.e., transmitting advertising information from the public right-of-way).

Active Logo Signing

Active logo signing represents an extension of the logo signing system present along many rural Interstate highways. It is considerably simpler than the deployment of the traveler information systems listed above but offers only a limited amount of information. The deployment process would be as follows:

- State DOT's make active logo signing available to program participants and establish a fee structure.
- Service providers make a determination as to whether the use of active logo signing is worth the cost.
- State DOT equips the sign(s) for the participating service providers, and fees are paid by the service provider.
- State DOT maintains the signs (could be by contract), ensuring a minimum of downtime and erroneous messages.

Because there may be a degree of uncertainty on the part of both the service providers and the State DOT's to undertake such a system, it is proposed that FHWA sponsor a limited field test to determine the viability of the concept and to gauge reaction of all parties involved, including motorists that stand to benefit from the system. The results of this field test (at up to three locations) will then be provided to the States to determine whether and how to proceed with implementation.

SUMMARY

As indicated from the above discussions, the road map to deployment for rural ATIS is likely to ultimately be the responsibility of the private sector. However, it is an opportunity for a true public/private partnership. Of the public partners, FHWA will have the greater responsibility in the early stages, with emphasis on resolving key research issues and gauging the user acceptance and potential implementation issues. States and local agencies will tend to be the partners in the deployment stages.

Some of the FHWA activities on rural ATIS may occur in parallel with other efforts being undertaken by the private sector in the same or different arenas. Development and deployment work is already being pursued by the private sector, as indicated earlier in this report. FHWA should be prepared to adapt its research program to these developments, try to address research issues unlikely to be addressed by the private sector, and address issues that may not be adequately addressed but that are in the public interest.

CHAPTER 4. RECOMMENDED ACTIONS

The result of all the preceding project activities - user needs assessment, technology survey, concept development and assessment - is a list of recommendations for future rural ATIS initiatives in which FHWA could play a critical and important role. These recommendations were developed based on a combination of the following three factors:

1. The project team's comprehensive survey of user needs and the priorities of service providers in rural areas.

2. The extensive experience of the expert panel members in addressing rural transportation issues and the role that ATIS might play in improving the safety and productivity of rural transportation.

3. Critical areas identified under 1 and 2 above which are not currently being addressed by other initiatives and in which FHWA could play a critical and important role going forward.

The recommendations fall into three basic categories of action:

- Research.
- Prototyping.
- Field Test.

Each ATIS initiative has been outlined according to the objective, description, technologies utilized, recommended actions, cost (low, mid, or high), and potential benefits gained by implementation of the technology. The evaluation of each initiative was also based on items 1 and 2 above. Figure 10 shows recommended action versus several criteria identified for potential ranking of the action items. The remainder of this chapter details each recommended action in terms of the objective, need, ITS program plan relevance, expected outcome, cost, risk, and responsible entities.

RESEARCH

Action items which fall into the research category are seen as requiring long-term technical research efforts. These concepts, or elements of the concepts, seem to be highly suited to rural ATIS applications but have an element of uncertainty which renders them unsuitable for immediate implementation. The concepts may be high risk and only successful if they also have a high pay-off. They may also be pushing the technological frontier, relying on technologies which have not been fully developed at this time.

PROTOTYPING

Emerging technologies suitable for rural ATIS, which have had little or no application to date, are candidates for prototyping. These technologies or concepts need to be investigated to determine technical proof-of-concept: Does the concept actually work and does it work as it was intended? The value of the concept can also be determined at this point. It is possible that prototype concepts will use elements of existing initiatives or projects. Each prototype will undergo a highly focused, formal evaluation of its performance, applicability, and potential for further development.

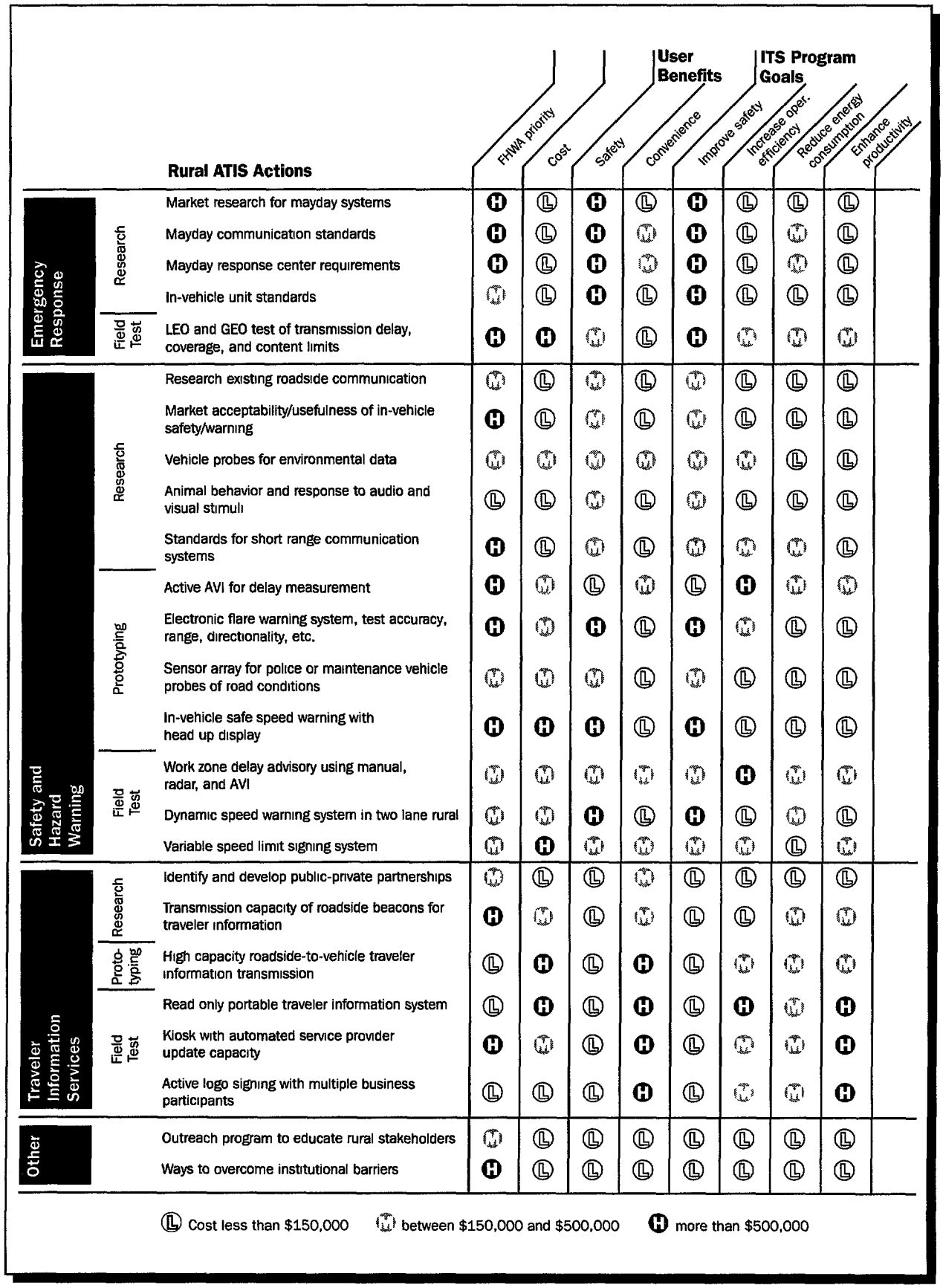

Figure 10: Recommended Actions Matrix

FIELD TESTS

Field tests are recommended for several rural ATIS concepts. These concepts, or elements of the concepts, already have real-world working applications. Field tests for these concepts will show that their application in a rural environment is useful and possible. The following items recommended for field tests may require significant effort to make them worthwhile, but they also present a major opportunity for rural ATIS. The field tests are classified according to emergency response, safety and hazard warning, and traveler information services.

OTHERS

General Research

There are several areas where FHWA involvement could foster rural ATIS deployment. The two areas identified from this project include work on a rural ATIS outreach program and on ways to overcome institutional and legal barriers to deployment.

Development of an Outreach Program

An outreach program is proposed for the purpose of educating rural States and localities of the potential for rural ATIS applications. This program could be a new effort aimed specifically at rural ATIS or could be integrated with other outreach efforts for ITS overall. While the integration with other outreach efforts would be an efficient approach, it would not be as effective for the promotion of rural ATIS compared to having a targeted effort.

Research on Resolution of Institutional and Legal Barriers

While there has been research on institutional and legal barriers to ITS, there are a number of issues that need to be resolved before some elements of rural ATIS can take place. The most notable barrier is the limitation of private sector involvement in disseminating services information from locations on the public right-of-way. The proposed effort is aimed primarily at relaxing restrictions on private sector provision of information on the public right-of-way. This will allow, for example, State tourism bureaus to contract with information brokers to establish comprehensive information systems at State welcome centers. It will also open the door to transmission of services information from roadside transmitters.

EMERGENCY RESPONSE

Promote the Research and Development of Standards for Mayday Systems

Objective

To ensure that all mayday systems are compatible nationwide and that message transmission standards are established.

Overview

As motorists travel across various regions of the country, they will travel through a broad range of emergency jurisdictions. Within these regions it is important that a car's in-vehicle unit is compatible with each of the response centers.

Need

Several standardization issues exist in mayday systems. Research and development would answer questions about content, transmission, establish requirements of an in-vehicle unit, and determine the criteria for the response centers (e.g., 911 centers).

Recommended Actions

Promote the research into and development of standards for mayday systems based on input from potential stakeholders including component manufacturers, communication media sources, and response centers. Care must be taken not to constrict the advancement of technology while developing and implementing standards.

Expected Outcomes

In-vehicle units requirements, including:
- size of unit
- ability of the unit to automatically sense a collision
- accommodate manual emergency service request
- input/output abilities of the unit
- power requirements
- antenna size and location requirements
- transmission of data necessary to guide the emergency service to the accident site

- Communication standards established, including:
  - acceptable delay in message delivery
  - message length and capacity
  - maximum message transmission time
  - message content (e.g., vehicle location, identification, nature of the emergency)
- Needs of the response center:
  - hardware and software requirements to support systems
  - ability of the system to detect and react to false alarms
  - each center must be standardized to ensure they can receive and interpret all transmissions
- Establish national communication standards to ensure:
  - each manufacturer's in-vehicle unit is compatible with the emergency response centers for all States
  - every system adheres to the requirements for data transmission (e.g., transmission rate, capacity, content)

Cost Low (<$150,000

Risks
- Stringent standards could slow or halt the development of mayday systems.

Responsibility

FHWA: Sponsor to oversee development.

Public:
- Participate in development process.

Private Sector:
- Participate in development process.

Assess User Acceptance for Mayday Systems

Objective	To determine the private industry support for rural mayday systems.
Description	It is envisioned that mayday systems will operate through private distributors. A distress signal will be received by a private operating center. This center will determine the validity of the signal and notify the necessary authorities (e.g., a 911 center). In-vehicle units will be sold through automobile manufacturers and electronics manufacturers.
Need	In order to have confidence in the consumer base, manufacturers of the units and providers of the mayday service need to know how much people are willing to pay for mayday, and how they want to pay for it (e.g., monthly fee, per use fee). Market research will determine this information.
Importance to FHWA's ITS Program Plan	- Addresses goal to improve the safety of the Nation's transportation system. · Addresses goal to enhance the personal mobility and the convenience of the surface transportation system.
Recommended Actions	It is recommended that FHWA perform assessment of user acceptance of mayday systems. This includes finding out public response to a mayday system, as well as determining the private market that will be created to manufacture in vehicle units and operate mayday.
Expected Outcome	- Determine how much the public will pay for a mayday unit. · Determine how the public wants to pay for mayday (e.g., flat fee, per call fee). · Determine private sector interest in managing mayday response centers.
Cost	Low (<$150,000)
Responsibility	
FHWA:	- Oversee the research.
Private Sector:	- Determine manufacturing costs for units.

Research Mayday Response Center Requirements

Objective	Determine the requirements for the mayday response center.
Overview	A response center will be the heart of the mayday system. Distress signals from in-vehicle units will be screened by the center, and information will be forwarded to the necessary authorities. Data capacity, dispatch time, hardware and software requirements, and staffing requirements are all unanswered questions in the mayday arena.
Need	The questions that exist with respect to mayday response centers are dependent upon several factors (number of users, type of communications used, compatibility, computer hardware and software, etc.). These questions must be answered if the private sector is expected to invest in the dispatch centers.
Importance to FHWA's ITS Program Plan	. Addresses goal to improve the safety of the Nation's surface transportation system. . Addresses goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.
Recommended Actions	FHWA should research the requirements of a response center.
Expected Outcomes	· Determine the data capacity requirements for a response center. · Determine the staffing requirements for a response center. · Determine communication requirements for a response center. · Establish requirements to detect a false alarm.
Cost	Low (<$ 150,000)
Responsibility	
FHWA:	. Oversee the research.
Private Sector:	. Provide input on requirements.

Research Promotion of Development of In-Vehicle Mayday Unit Standards

Objective

To determine the standards for the in-vehicle component of a mayday system.

Overview

The in-vehicle unit senses an accident, signals the response center, and guides the emergency service to the accident site.

Need

There are several issues associated with the in-vehicle unit. It must accommodate manual response, provide sufficient information for accurate location of the accident site, and perhaps provide automated collision sensing and activation. The unit also must be small, durable, and fully compatible with all hardware and software at the response centers. Failure to sense a collision, faulty route guidance, lack of manual inputs, or incompatibility with the response center hardware and software could delay emergency response or make the system useless. Standards for design will help ensure these variables are adequately addressed.

Importance to FHWA's ITS Program Plan

- Addresses goal to improve the safety of the Nation's surface transportation system.

Recommended Actions

It is recommended that FHWA research and promote the development of standards for in-vehicle mayday units to ensure quality and compatibility in these systems.

Expected Outcomes

- Determine the compatibility requirements of the in-vehicle units.
- Determine what route guidance capability is necessary for the units.
- Determine what durability requirements are needed to ensure the in-vehicle unit survives an accident.

Cost

Low (<$ 150,000)

Risks

- Requirements could be so constraining that construction of the in-vehicle unit is impossible.

Responsibility

FHWA:

- Research and promote development of standards.

Private Sector:

- Review the standards to ensure that they are within reason and will not impede implementation of mayday.

Field Test of Communication Systems for Mayday

Objective

To field test various satellite mayday concepts and determine which communication medium is best suited to meet the demands of an automated/manual emergency notification system.

Overview

Mayday systems all operate on the same basic principle. An in-vehicle unit activates a distress signal when an incident is detected from manual inputs or automated sensor inputs (such as rollover sensors or air bag sensors). This accident information is transmitted from an in-vehicle unit to a receiver at a response center (e.g., 911 center) where the necessary help is dispatched.

Need

The average response time from a vehicle crash to emergency medical service (EMS) is 22.39 minutes on a rural Interstate and 17.85 minutes on other principal roadways. A large portion of this response time (9.30 minutes on Interstates and 7.20 minutes on other principal roadways) is the time consumed to notify the EMS of a crash. An automatic dispatch system (i.e., mayday) would basically eliminate this time delay, translating to a 12.78 minutes and 10.59 minute response time for EMS on Interstates and other principal roadways, respectively. This decreased response time would save lives and reduce the impact of injuries occurring in these accidents. A crucial piece of the mayday puzzle is to determine which of the up and coming communication systems will best address the needs of rural mayday.

Importance to FHWA's ITS Program Plan

- Addresses the goal to improve the safety of the Nation's surface transportation system.
- Provides vehicle-to-infrastructure communication link necessary for other user service implementations.
- Provides vehicle location functional commonality with route guidance user service.
- Fills a critical void in communication need for a comprehensive mayday system that covers rural areas.

Recommended Actions

It is recommended that FHWA design and test both LEO- and GEO-based mayday systems. These field tests will determine data transmission capabilities (e.g., message capacity, delay times), cost of implementation, cost of data transmission, compatibility, and the actual EMS notification time savings of each system.

- GEO - Geosynchronous orbiting (GEO) satellite systems eliminate the need for the radio towers of terrestrial mayday. They depend on the satellites in synchronized orbit around the earth and the position of the user on the earth's surface relative to an orbiting satellite.

- LEO - The low earth orbiting (LEO) satellite systems rely on an array of satellites orbiting the earth. These systems are currently being developed by several companies. The system's main focus is to provide broad coverage for users of satellite communication.

Expected Outcomes

- Determine which system offers the best coverage of the rural United States.
- Determine which system has the highest degree of compatibility with response centers.
- Realization of the actual cost of each system to implement and transmit data.
- Determine the time delay associated with the data transmission for each system.
- Ascertain the actual capacity of data transmission for each system.

Cost

High (>$500,000)

Risks

- Success of the field test is dependent upon availabilities of LEO and GEO technologies.

Responsibility

FHWA:

- Develop test plan.
- Oversee the test.
- Provide funding for managing and conducting the test.
- Summarize findings of the field test.

Private Sector:

- Provide access to GEO and LEO links.
- Provide in-vehicle devices.
- Provide vehicle location function.
- Interface with response center to provide emergency response resource.
- Provide route guidance to emergency response resources.

SAFETY AND HAZARD WARNING

Research Existing Roadside Communication Systems

Objective

Determine what communication systems are currently available for ATIS applications.

Overview

There are several communication devices and systems currently available off the shelf. These systems and components may be viable for ATIS applications. A formal search of these systems by FHWA will ensure that suitable systems for ATIS applications are not overlooked.

Need

Several ATIS applications depend upon roadside capabilities of data transmission and reception, If communication systems appropriate for ATIS exist, investments in the development of new communication systems would be misdirected. FHWA's formal investigation into existing technologies would ensure that future research efforts are properly directed.

Recommended Actions

FHWA should conduct a formal search of all potential communication systems for ATIS.

Expected Outcomes

- Learn exactly what is available for communication systems.
- Determine what systems, or components of systems, are of value in the ATIS arena.

Cost

Low (<$150,000)

Responsibly

FHWA:

- Conduct a thorough search of all existing communication systems.
- Document the findings of the study.

Private Sector:

- Provide information on product specifications and capabilities.

Research Market Acceptability and Usefulness of **In-Vehicle Safety Devices**

Objective	Determine how consumers will respond to in-vehicle safety devices.
Overview	The in-vehicle safety devices will be an expense born by the travelers who choose to purchase a system (or an automobile equipped with a system). The willingness to pay for these systems will depend on the level of safety benefits the public feels that they will gain from a safety system.
Need	The market for in-vehicle safety devices will develop as the public perceives them as a viable safety enhancement. In order to gain further support from stakeholders, FHWA must be aware of the level of support that exists in the industry. It should be determined what consumers expect from a system and what consumers are willing to pay for a system.
Importance to FHWA's ITS Program Plan	· Addresses the goal to improve the safety of the Nation's surface transportation system. · Determines the public perception of ITS technologies.
Recommended Actions	FHWA should research the marketability and public perceptions of the usefulness of in-vehicle safety devices.
Expected Outcomes	· Understand the public perception of in-vehicle safety devices. · Help to determine the market that exists for ITS safety technologies.
Cost	Low (<$150,000)
Responsibility	
FHWA:	- Oversee the research.
Private Sector:	· Provide market information on current activities.

Research and Identify Vehicle Probe Statistics

Objective	Determine how many vehicle probes are needed to obtain statistically valid information.
Overview	Vehicle probes work by equipping a fleet of vehicles with sensors to determine weather and road conditions. The vehicles then "dump" the data to a roadside processor. The processor relays information about the road conditions to motorists entering the area as they pass the roadside beacon.
Need	Several statistical issues exist with vehicle probes. The number of sensor readings per highway mile, the number of vehicles per highway mile and the number of beacons per highway mile are all factors that affect the validity or the data.
Importance to FHWA's ITS Program Plan	- Addresses goal to improve the safety of the Nation's surface transportation system. • Provides statistical data necessary to conduct an effective test of vehicle probes.
Recommended Actions	It is recommended the FHWA conduct the research necessary to determine the number of probe vehicles, the number of beacons, and the frequency of readings per highway mile necessary for statistically valid traveler information.
Expected Outcomes	- How many vehicles are needed to obtain sufficient data. · How many beacons are needed to process and disseminate the information. · How frequently must a sensor take a reading to obtain sufficient data.
Cost	Mid ($150,000 - $500,000)
Risks	- Inaccurate statistical information could result in travelers being provided with incomplete, unreliable information.
Responsibility	
FHWA:	- Conduct the research needed to obtain statistical data.
Private Sector:	- Provide available information to assist the public sector.

Research Animal Warning Systems

Objective

Research warning systems that deter animals from the roadway and/or systems that alert travelers of animals on the roadway.

Overview

There two types of animal warning systems that could be researched by FHWA.

1. Systems that frighten the animals away from the roadside through methods such as high frequencies noise or light reflectors (at night).
2. Detection devices that warn travelers of animals ahead on the roadway.

To date, there has been limited success with either system.

Need

Technologies exist that are capable of detecting animal presence (such as infrared); however, the price of these technologies is beyond the reach of normal motor vehicle operations. Animal deterrent systems have been analyzed, with little credibility given to systems that have used roadside headlight scattering or high frequency devices (e.g., "deer whistles") designed to scare animal from the roadside.[4] Collisions with animals cost motorist millions of dollars every year, and any system that reduces the number of accidents will be of value in the ITS arena.

Importance to FHWA's ITS Program Plan

- Advances goal to increase the safety of the Nation's surface transportation system.
- Advances goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.

Recommended Actions

FHWA should continue to research methods to scare animals from the roadside. Motorist in all areas, especially rural areas, would benefit from the development of a successful, economically feasible animal deterrent.

Expected Outcomes

- Determine a viable method to deter animals from the roadway or alert travelers of animals on the roadway.

Cost

Low (<$ 150,000)

Responsibility

FHWA:

- Conduct the research.
- Document findings of the research.

Private Sector:

Provide documentation and results of testing of existing systems.

Promote Standards Development for Short Range Communication Systems

Objective

Define the standards for short range communication for ATIS applications.

Overview

Several technologies in ITS rely on roadside communication with vehicles, including:

- Railroad crossing warning systems.
- Weather and road condition monitoring using vehicle probes.
- Roadside safe speed warning systems.
- En route portable tourist-information systems.
- Work zone delay advisory systems.
- Variable speed limit signing with head-up displays.

These systems will use similar technologies for roadside transceivers receiving and disseminating information to and from vehicles. To ensure that these systems are compatible with each other, standards must developed for communication. This will aid in the advancement of these and future ITS activities.

Need

As people travel across the country, it is envisioned that they will encounter many roadside systems for ATIS technologies. The infrastructure supporting these systems must be developed so that an in-vehicle device will be able to receive data transmitted from roadside systems, regardless of the particular roadside system. Communication standards will ensure that the systems are compatible nationwide.

Importance to FHWA's ITS Program Plan

- Addresses the goal to improve the safety of the Nation's surface transportation system.
- Addresses the goal to enhance present and future productivity.
- Enhances the personal mobility and the convenience and comfort of the surface transportation system.

Recommended Actions

FHWA should promote the development of standards for ITS roadside communication media.

Expected Outcome

- A standard short range, roadside communication system that can be used by several technologies.
- A more rapid advancement of technologies around a predetermined, standard communications base.

Cost

Low (<$150,000)

Risks

- Standards may be developed that impede the development of new technologies for ITS.

Responsibility

FHWA:

- Promote develop and implementation of communication standards.

Private Sector:

- Develop communication standards.

Prototype Active AVI for Delay Measurement in Work Zone Delay Advisory System

Objective

Determine the value of using active AVI to determine travel time with transmission of delay to changeable message signs in work zone delay advisory systems.

Overview

An option for the work zone delay advisory system is to develop a prototype active AVI system. AVI readers (for tagged commercial vehicles) will be set up at specific stations in the work zone; at least two stations are needed. Detection stations identify the same vehicles at different locations, tracking them through the network and obtaining information on travel times and speeds. A central processor determines the approximate delay at construction zones and transmits this information to a CMS.

Need

Traffic delays may be extensive in rural areas. Often there is little or no warning associated with these delays. Alternative routes are often limited, and if they are available, the traveler is often unaware of the need to detour until it is too late. Work zone delay advisory would reduce driver stress by informing the traveler of the anticipated delay time and help to determine if an alternate route is worth considering.

Importance to the FHWA ITS Program Plan

- Uses a technology that is already in place to further enhance another independent technology.

Recommended Actions

FHWA should prototype an active AVI system in construction zones in a location where CVO vehicles are using AVI technologies.

Cost

High (>$500,000)

Risks

- AVI tagged vehicles must operate on the same frequencies.

Responsibility

FHWA:

- Provide seed money for the test.
- Oversee the prototype testing.
- Determine optimum location for testing a prototype where AVI is being used in another application.

Private Sector:

- Cooperate with FHWA to ensure the systems are operable.

Prototype of Electronic Flare Warning System

Objective

To provide motorists with advanced notice that they are approaching a potential hazardous situation.

Overview

Electronic flare warning systems consist of three system components:

- A transmitter to broadcast a warning from the hazard (e.g., vehicle operating at slow speeds).
- An in-vehicle receiver that can receive the warning transmission.
- A communication system over which to broadcast the message.

Three levels of systems have been analyzed as potential systems for an electronic flare warning system.

Level 1 - A flare is turned on which enables a radio transmitter. This transmitter generates and broadcasts a radio signal.

Level 2 - A more elaborate message is sent (text or audio) to the approaching driver and is received on an in-vehicle user interface, giving a basic description of the nature of the advisory. The signal will be sent with a specific signature or code which the receiving device will recognize. The receiving device will flash a brief text message on a small display accompanied by an audio tone to warn approaching vehicles. This allows for a more descriptive message (e.g., "SCHOOL BUS AHEAD").

Level 3 - This implementation will allow text input to produce the exact message desired in a form that the oncoming vehicle will interpret, which in essence provides a one way communication network. This greatly increases the functionality as well as the complexity of the system.

Need

Slow moving vehicles and vehicles that make frequent stops are common in rural areas. Examples of these vehicles include school buses, farm equipment, roadway maintenance vehicles, and mail delivery vehicles. At the same time, rural average vehicle speeds and speed limits are higher than those in an urban environment. The combination of these two factors results in a disproportionate number of rural fatalities. In fact, 79 percent of the 18,119 fatal accidents on roadways with speed limits of 88 km/h (55 mi/h) or greater in 1993 occurred in rural areas. Additionally, school bus transportation accidents killed 141 people and injured 20,000 in 1993. Restrictive roadway geometric features in rural areas also result in a difference in accident characteristics between the rural and urban environments. These features can include narrow roads, sharp comers, and limited sight distance. Some accidents that occur because of these factors could be avoided if drivers were alerted to dangerous situations prior to encountering them.

Importance to FHWA's ITS Program Plan

- Addresses the goal of improved safety of the surface transportation system.

Recommended Actions

To develop a successful prototype of an electronic flare warning system, FHWA must identify the stakeholders of the technology, form a test team, develop communication standards, and finally develop the prototype transmitters and receivers. The prototypes must be tested in an area with a historically high incidence of accidents that the flare system would help. A prototype must address accuracy, range, data type, and directionality.

Expected Outcomes

- Determine the extent that safety is enhanced through electronic flare warning system.
- Prototype vehicle-to-vehicle communication in ITS applications.
- Consensus on standards and system design will be reached among stakeholders.
- Prototype tested and evaluated.
- Full-scale implementation recommendations made.

Cost

High (>$500,000)

Risks

- Dependent on manufacturers of communication system.

Responsibilities

FHWA:

- Ensure nationwide compatibility and standardization.
- Provide seed money to conduct the test.
- Oversee the test.

Private Sector:

- Provide transmitters.
- Provide receivers.

Prototype Weather and Road Condition Monitoring Probes

Objective	Develop and test a weather and road condition monitoring system that can determine up-to-date road conditions using vehicle probes and relay the conditions to travelers driving into the area.
Ovdrview	A fleet of vehicles (such as police and/or maintenance crews) will be equipped with an array of sensors. These sensors will measure surface friction, forward visibility, wind speed, and other environmental conditions. The information will then be transferred from the vehicle probe to a roadside station via a communication medium. This station will then deliver the information to travelers through some type of interface. This interface may be an in-vehicle device (such as a head-up display) or an external device, such as a changeable message sign. This will provide the driver with real-time information about conditions that exist ahead.
Need	Adverse weather conditions and poor roadway conditions brought about by bad weather are factors in a significant percentage of rural accidents. The most significant meteorological parameters which affect drivers and their safety are rainfall, snow, ice, fog, and wind. In rural areas, there are limited (if any) means to inform travelers of upcoming weather and road conditions. The effects of the adverse weather conditions may be compounded by poor geometrics and driver unfamiliarity with the area.
Importance to the FHWA's ITS Program Plan	. Addresses the goal of improving the safety of the Nation's surface transportation system. . Addresses the goal of personal mobility and the convenience and comfort of the surface transportation system.
Recommended Actions	Develop and test a prototype on a police and/or maintenance fleet in a rural area with diverse weather conditions.
Expected Outcomes	· Ensure integration with the other national ATIS applications that may be inter-operable with the system. • Spur other ATIS activities with roadside probe communication. · Determine the worth of an environmental sensor. · Determine the possibility of vehicle to roadside communication for ITS applications. · Determine the possibility of roadside to vehicle communication for ITS applications.
Cost	Mid ($150,000 - $500,000)
Risks	· The success of the program is dependent on participation by a multitude of public agencies (e.g., State DOT's, local agencies) and the development of prototypes by the private sector.

Responsibility		
FHWA:	·	Identify appropriate partners in the public and private sector.
	·	Develop and enforce system specifications.
	·	Provide a catalyst for moving forward with a meaningful program.
States:	·	Install, monitor, and maintain the systems.
	·	Provide support by outfitting fleet vehicles with necessary equipment.
Public Safety Agencies:	·	Provide access to local fleet vehicles to use as probes.
Private Sector:	·	Provide prototype systems.

Prototype an In-Vehicle Safe Speed Warning With a Head-Up Display

Objective	Develop a prototype of a head-up display in conjunction with a safe speed warning system.
Overview	Areas that combine poor geometrics with adverse weather conditions have been identified as optimal locations for roadside safe speed warning systems. As head-up displays continue to enter the market place their capabilities may be upgraded to receive dynamic data.
Need	Travelers in a rural environment are often faced with adverse weather conditions on roads with poor geometric alignments and steep grades. A roadside safe speed system could be set up to broadcast a message that would be received by an in-vehicle unit and displayed to the driver on a head-up display. This would allow the driver to receive information without taking his eyes from the roadway.
Importance to FHWA's ITS Program Plan	. Addresses goal to improve the safety of the Nation's surface transportation system. . Addresses goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.
Cost	High (>$500,000)
Responsibility	
FHWA:	. Oversee the development and testing of the prototype. . Summarize the results of the activities.
Private Sector:	. Provide head-up display prototype.

Field Test of Work Zone Delay Advisory System

Objective

The work zone delay advisory (WZDA) system will provide travelers with delay times and messages at construction zones.

Overview

There are three different levels of WZDA that could all have applications in the real-world environment.

1. Static signs with flashers that are activated when delays are present. The flasher would indicate that the traveler can expect construction activities and delays associated with the construction.
2. A system that uses speed sensors to determine the approximate delay through the work zone and CMS to deliver an automated message to travelers. This system would give drivers information such as the reason for the delay and the time associated with the delay.
3. An automatic vehicle identification (AVI) travel time monitoring system, which more accurately determines the delay at work zones.

Need

Construction and maintenance work zones occur on thousands of miles of roadway every year - a good portion in rural settings. Current construction maintenance of traffic plans and practices usually incorporate a static sign upstream of the work zone displaying a continuous message advising of roadway construction and to expect a delay. There is no active determination of the delay in most situations, and, therefore, the static signs are left in place throughout the duration of the work regardless of whether or not delays exist. Drivers lose respect for these type of messages and experience unexpected inconvenience and frustration. In addition, travelers may be convinced to avoid construction or maintenance areas because of unexpected delays, even when there really are none.

Importance to FHWA's ITS Program Plan

- Addresses the goal to improve the safety of the Nation's surface transportation system.
- Portable detection and display system will help advance ITS in several dimensions including.
  - emerging surveillance technologies
  - portable displays
  - portable communication systems
  - integration of elements into an affordable system
- Addresses the goal to increase the operational efficiency and capacity of the surface transportation system.
- Addresses the goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.

Recommended Actions

All options are recommended for field tests. The technologies needed for these systems are currently being used in similar activities, and the application to WZDA systems would be an easy transition. A cost-benefit analysis will determine which (if any) of the systems should be further developed for long-term use.

Expected Outcomes

- Test the accuracy of delay measured with different technologies (radar for "spot speed" and AVI).
- Determine what driver benefits are actually accrued from delay information (e.g., do a significant number reroute? are accidents reduced? do drivers feel less stress?).
- Measurement of improved safety for roadside workers.
- Test roadside to vehicle communications technologies for future ATIS applications.
- Determine the ability of construction crews to set up and take down the WZDA systems.
- Areas appropriate for WZDA systems will be established.
- Motorist perception and reaction to the WZDA will be determined, and driver benefits will be validated.

Cost

Option 1 Low (<$100,000)
Option 2 Mid ($150,000 - $500,000)
Option 3 Mid ($150,000 - $500,000)

Risks

- Dependent upon cooperative efforts between FHWA, State DOT's, and manufacturers of the WZDA components.

Responsibility

FHWA:

- Oversee development of the test.
- Overall management of the test.

States:

- Maintain the WZDA system.
- Install and take down WZDA systems.
- Assist in determining locations for WZDA systems.

Field Test of Variable Speed Limit Signing System

Objective

The variable speed limit signing (VSLS) system will provide travelers with a safe speed on rural roads based on environmental and geometric conditions

Overview

A CMS delivers a safe speed to travelers, and gives the reason for any reduction in the normal speed. This is accomplished through a system that uses environmental sensors to measure pavement and atmospheric conditions, a roadside processor to process the data, and a CMS to relay the information to a traveler. A series of stations linked by radio or cellular communication, warns drivers of upcoming conditions through a section of roadway. This type of system would be used on long stretches of highways through regions characterized by poor weather and geometrics.

Importance to the FHWA ITS Program Plan

- Helps meet the ITS goal of improved safety.
- Provides station to station infrastructure link that may prove to be valuable in future ITS technologies.
- Provides tests of alternative power sources in remote settings.

Recommended Actions

The VSLS system should be further tested in full capacity (incorporating all aspects of communication and environmental sensors) in remote rural settings.

Expected Outcomes

- Test the ability of VSLS to reduce accidents in rural environments.
- Determine driver perception of and reliance on variable speed limits.
- Test the ability to implement roadside to roadside transmitter communication in a cost effective manner.
- Test of communication from station to station in remote settings.
- Test the capabilities of alterative power sources in remote, environmentally challenging conditions.
- Determine optimum locations for VSLS in remote, rural settings.

Cost

High (>$500,000)

Risks

- To date, the technology has not proven itself in operational tests as an effective transportation enhancement.

Responsibility

FIIWA:

- Develop test plan.
- Oversee the test.
- Summarize the findings of the test.

States:

- Identify primary locations to test all aspects of a VSLS system.
- Collect data from the study.
- Oversee maintenance of the system.

Private Sector:

- Provide prototypes for test use.
- Provide communications links (e.g., satellite and cellular).

Field Test of Roadside Safe Speed Warning Systems

Objective

The roadside safe speed warning system provides drivers with an indication of safe speed based upon vehicle weight, topography, roadway geometry, and environmental conditions.

Overview

This system uses weigh-in-motion technology, speed detectors and environmental sensors to determine the safe speed for a vehicle in areas where steep topography and poor geometrics are prevalent. Drivers are informed of conditions (e.g., steep grades} and of the safe speed for their vehicle for the conditions.

Need

Within the 80 percent of the Nation's roadway system located in rural areas, there are many areas of diverse topographical changes, roadway geometry, and weather changes. These conditions pose different threats to various types of automobiles (tractor trailers, passenger vehicles, public transit vehicles, etc). Static signs and other existing techniques usually do not provide drivers with adequate information to avoid serious accidents. Therefore, there is a need for a dynamic method to advise a driver of these upcoming situations, primarily in the form of real-time, safe travel speed advisory.

Importance to FHWA's ITS Program Plan

- Addresses the goal of improved safety on the Nation's surface transportation system.
- Addresses the goal of increasing personal comfort and convenience of the surface transportation system.

Recommended Actions

Currently, FHWA is involved in an operational test for a system based upon vehicle weight and topography. Further investigation should follow up these tests to ascertain the possibility of using environmental sensors in such systems. Such testing will determine the worth of a system in determining a safe speed for any given weather condition, and the value of the system will be fully ascertained.

Expected Outcome

- Determine how well vehicles follow posted variable speed limits and whether the signs help reduce the accident rate.
- Provide en route, real-time, vehicle specific safe speed warning for all vehicles on the roadway system.
- Improve site-specific roadway and weather conditions coverage.
- Increase in traveler and roadway safety on publicly owned roadways.
- Provide more accurate, comprehensive, reliable, and up-to-date safe travel speed advisories than that of static signing or no signing.
- Potential for better roadway operations (e.g., fewer accidents, uniform travel speeds).
- Complement runaway truck ramps by decreasing the probability of necessitating the use of these ramps.
- Offer practical and inexpensive alternative to highway construction for the correction of under designed highway ramps and curves and other hazardous geometric roadway conditions.
- Eliminate the need to purchase additional right-of-way and land to correct roadway problems.
- Determine the ability to locate and install roadside safe speed warning systems.

Cost Mid ($150,000 - $500,000)

Risks

- Liability of untested technologies.

Responsibility

FHWA:

- Develop test plan.
- Oversee the test.
- Summarize the findings of the test.

States:

- Identify primary locations to test all aspects of a variable speed limit signing system.
- Collect data from the study.
- Oversee maintenance of the system.

Private Sector:

- Provide prototypes for test use.
- Provide communication links (e.g., satellite, cellular).

TRAVELER INFORMATION SERVICES

Research Potential Public Private Partners for Tourist-Information Systems

Objective

Determine the best approach to private funding of portable tourist-information and kiosk systems.

Description

A large concern with information system applications in rural ATIS is who will pay for these services. Research of public-private partnerships by FHWA will accomplish two things:

1. The private sector will bear some cost of the systems
2. Commercialization to support the system will increase public awareness of ATIS and create support for future activities.

Need

Portable tourist-information and kiosk systems are activities planned for implementation that will provide traveler services information. By definition, these systems will provide travelers with information on tourist attractions, lodging, and restaurants. It should follow that the private industry will support the activities through competitive advertising of goods and services. Furthermore, the public involvement will ensure that the information relayed is accurate and appropriate.

Importance to FHWA's ITS Program Plan

- Provides an alternative source of funding for ITS activities.
- Addresses goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.

Recommended Actions

Research public and private markets for applications of ATIS associated with tourism.

Expected Outcomes

- Identify private partner brokers to manage and market the advertising.
- Determine the level of support in the tourism industry to support portable tourist-information and kiosk systems.

Cost

Low (~$150,000)

Risks

- Too much public influence could result in a strictly profit-oriented system that may not address tourism needs that are not profit motivated (e.g., routing to avoid a traffic problem).

Responsibility

FHWA:

- Research the markets.

Private Sector:

- Provide information relative to market possibilities.

Research the Transmission Capacity of Roadside Probes

Objective

To determine the capacity of a roadside transmitter to download traveler information.

Overview

As vehicles equipped with traveler information systems travel pass a roadside station at mainline speeds, they will receive information. To be effective, the roadside transmitter must be able to send a large amount of data (e.g., maps, travel services, traffic information) very quickly.

Need

Currently, many communication systems exist that could potentially serve as roadside beacons to deliver traveler services information. It is crucial to determine which (if any) of the systems have the transmission capacity to deliver the data required by a traveler information system to a vehicle traveling at mainline speeds.

Importance to FHWA's ITS Program Plan

- Addresses goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.
- Research conducted could potentially affect other future ITS activities.

Recommended Actions

It is recommended that FHWA research communication systems for TIS roadside transmission to determine which systems best address the TIS needs.

Expected Outcomes

- Determine what systems offer the best transmission capacity.

Cost

Mid ($150,000 - $500,000)

Risks

- Determining which system will be used for systems in the early stages of the development could inhibit future discoveries of applicable systems.

Responsibiiity

FHWA:

- Oversee the research of communication systems.

Private Sector:

- Review the findings to assure a thorough survey has been conducted.

Prototype a High Capacity Roadside-to-Vehicle Traveler Information Transmission

Objective

Develop a system with the ability to deliver real-time traveler information from roadside beacons to portable tourist-information systems in moving vehicles.

Overview

A concept recommended for further development is the implementation of a roadside system. Travelers will be able to rent a portable device that receives information from roadside beacons. The information could include lodging and dining information, local sites, and road conditions. A large quantity of data (e.g., maps, traffic data, site info) must be transmitted to a moving vehicle.

Need

A goal of traveler information systems is to provide travelers with convenient, up-to-date traveler information. In order to ensure that information is convenient, data should be received without having to stop and download manually from a data bank. To accomplish this while ensuring that travelers are informed of real-time conditions, it is necessary to transmit a large quantity of data from roadside beacons to vehicles moving at mainline speeds.

Importance to FHWA's ITS Program Plan

- Addresses the goal of enhancing the personal mobility and convenience and comfort of the surface transportation system.
- Addresses a transmission test that could have implications in future ITS applications.

Recommended Actions

The TIS prototype could be developed and then analyzed in an operational test. This could be incorporated into the operational test of a preprogrammed device.

Expected Outcomes

- Receptiveness and support of private sector to upcoming ITS benefits for the tourist industry.
- Find the potential for roadside to vehicle communication.

Cost

High (>$500,000)

Risks

- A high enough rate of transmission may prove to be impossible or very costly.

Responsibility

FHWA:

- Provide seed money to spur the test.
- Solicit service providers/advertisers.
- Oversee the test.

Private Sector:

- Maintains interface units.
- Assist in the development of the receiver.
- Assist in the development of the transmitter.

Field Test of Read-Only Portable Tourist-Information Systems

Objective

The read-only portable tourist-information system can provide travel directions, information on lodging, dining, attractions, and motorist services on a route-specific or regional basis.

Overview

Two options exist for the system.

1. A preprogrammed system that contains information on the region. The user would select a data base trip package for a specific traveling plan which provides information along the route.
2. En route systems provide a tourist with regional, up-to-date travel information through roadside-to-vehicle communication. A roadside transmitter would download area specific information as the vehicle passed.

Need

Almost 80 percent of the existing roadway system in the United States is found in rural areas. A number of motorists in these areas are often tourists or long distance travelers who are unfamiliar with their surroundings and are ordinarily isolated from needed or desired information while en route. These travelers often desire information concerning food and lodging facilities, motorist and traveler services, and attractions or points of interest along their route. When information is provided, it is often not available in a user friendly or readily understandable format. In the Rural ATIS study, over 68 percent of the long distance travel survey respondents rated information about facilities as somewhat or very important. Furthermore, AAA membership service for trip planning processes approximately 8.3 million information packages for tourists annually. These statistics indicate a need for an easy to use, accurate, portable tourist-information system.

Importance to FHWA's ITS Program Plan

- Addresses the goal of ITS to enhance the personal mobility and the convenience and comfort of the surface transportation system.

Recommended Actions

The preprogrammed option is recommended for operational testing (the other option is recommended for prototyping). FHWA should provide seed money for an operational test in a rural region with a variety of attractions connected by various types of roadways. The four State region of North Dakota, Montana, South Dakota, and Wyoming has been recommended for a site. This region comprises a vast rural roadway network, including Interstate highways, four-lane highways and two-lane highways. The area is also home to a number of large tourist attractions including Yellowstone National Park, the Dakota "Badlands," Mt. Rushmore, Jackson Hole, Wyoming ski resorts, and other recreational retreats. As option two evolves, it should be integrated into this operational test:

Expected Outcome

- Determine the level of support that exists from the private industry for tourist related ATIS activities.
- Determine public reaction to ATIS tourist information.
- Provide data integration with time dependent data.
- Ability and further potential for roadside-to-vehicle communication.

- Determine how much information can be passed to a moving vehicle.
- Determine expectations of service providers of tourist services.

Risks

- Dependent upon private sector's ability to create an extensive data base that would be valuable to tourists.

Cost

High (>$500,000)

Responsibility

FHWA:

- Develop the test plan.
- Summarize findings of the test.
- Provide seed money to promote interest in the test.
- Monitor the test.

Private Sector:

- Assist in funding the test.
- Maintain data bank of updated tourist information.

Field Test of Kiosks at Traveler Information Centers

Objective

Provide a traveler information center with real-time traveler information via automated kiosks in cooperation with the private sector.

Overview

The automated kiosk concept provides enormous opportunities for public-private partnerships and for a sustainable source of funds. These partnerships are already in existence in many areas. The typical scenario would involve three key parties:

- The advertising broker who assembles information from the advertisers or service providers.
- The advertisers or service providers who are willing to pay for the exposure of their information to the public.
- The public agency who not only owns the land along the roadways where these centers can be established, but also has a need to disseminate information to the public on the opportunities for visiting, shopping, dining, or lodging in the areas they represent.

A key method of advertising could exist through automated information kiosks. These computer based, touch screen information dissemination elements can provide real-time traveler information on tourist sites, dining, lodging availability, routing information, and traffic information.

Need

The kiosk concept seeks to build on a currently successful set of activities by adding technological enhancements. States currently spend a significant amount of money ($850,000 per year on average) on TIC's This money is perceived as money well spent, as it has an associated rate of return from the tourists. It stands to reason that ATIS applications at the tourist centers that would further promote the area would be a welcome addition.

Importance to FHWA's ITS Program Plan

- Opportunity to showcase ITS application in a highly visible, useful area.
- Advances the goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.

Recommended Actions

It is recommended that a field test, in which FHWA would work with one or more States and the private sector in a partnership, be undertaken to demonstrate the benefits of kiosks at rural TIC's.

Expected Outcomes

- What type of information the services industry is most interested in providing to rural travelers.
- How frequently the service providers would be interested in updating their information.
- How information would have to be organized to most efficiently and effectively communicate with the rural traveler.
- Information on travelers usage of the system (e.g., how many request per day).

Cost

Mid ($150,000 - $500,000)

Risks

- Dependent upon private sector's ability to create an extensive data base that would be valuable to tourists.

Responsibility

FHWA:

- Provide weather and traffic information.
- Provide seed money to spur the test.
- Add information to master data base (e.g., information on parks, construction, weather, and delays).

Private Sector:

- Solicit service providers/advertisers.
- Maintain master data base.
- Produce interface units, kiosks, other hardware/software.
- Maintain interface units.

Field Test Active Logo Signing Systems

Objective	To conduct a field test of active logo signing systems.
Overview	The active logo signing concept uses simple, dynamic displays on standard roadside specific service signs to indicate the status of services (e.g., open/closed, vacancy/no vacancy).
Need	Rural travelers unfamiliar with an area want to know not just what services are available at a specific location, but whether service stations and restaurants are open and if lodging and camping establishments have vacancies.
Importance to FHWA's ITS Program Plan	- Addresses goal to enhance the personal mobility and the convenience and comfort of the surface transportation system.
Recommended Actions	It is recommended that FHWA field test an active logo signing system.
Expected Outcomes	· Determine response to the signs (e.g., is the information valuable?, to what capacity do people rely on the signs?). · The extent that the private sector will help fund the additional advertising on the signs.
cost	Low (<$150,000)
Responsibility	
FHWA:	- Oversee the test. - Summarize the findings of the test.
Private Sector:	· Provide financial support in exchange for the advertising.

OTHER ACTIVITIES

Research and Outreach Program to Educate Rural Stakeholders

Objective

To develop a program to educate rural stakeholders of ATIS about ongoing and upcoming activities and their role in those activities.

Overview

There are several stakeholders of rural ATIS. These stakeholders include tourist promotion groups, State agencies, city organizations, and national parks. These groups have had limited involvement in ITS to date and may be somewhat unfamiliar with concepts and applications that could apply to their rural environment.

Need

The rural community has not been involved in ITS activities. As a result, there is limited knowledge on the status and applicability of ATIS activities in the rural United States. Potential stakeholders need to be identified and informed of ITS activities. In addition, stakeholders may have valuable input that FHWA should consider.

Importance to FHWA's ITS Program Plan

- Addresses goal to create an environment in which the development and deployment of ITS can flourish.

Recommended Actions

It is recommended that FHWA develop an outreach program to educate rural stakeholders about ATIS applications.

Expected Outcomes

- Rural stakeholders of ATIS will be identified.
- Rural ATIS, and ITS in general, will be promoted.
- A thorough study will create an information exchange which will enhance the rural stakeholders knowledge of ITS as well as further FHWA's understanding of the rural environment.

Cost

Low (<$ 150,000)

Responsibility

FHWA:

- Create an outreach program that will educate as many rural stakeholders as possible.
- Open and maintain a mutual exchange of information with the rural community.

Private Sector:

- Work with FHWA to better understand and contribute to the ITS program.
- Pass along information to other private parties.

Research and Identify Institutional Barriers to Rural ATIS

Objective	To resolve institutional issues of rural ATIS.
Overview	There are obvious institutional barriers to rural ATIS projects. The two most prominent are the competition for limited funding and the reluctance to share or relinquish jurisdictional authority.
Need	The institutional barriers pose serious impediments to ATIS. There is limited private involvement in disseminating information from locations on the public right-of-way. Several ATIS applications would benefit from relaxed right of way use restrictions. This barrier, and other barriers, must be identified and overcome.
Importance to FHWA's ITS Program Plan	· Addresses goal to create an environment in which the development and deployment of ITS can flourish.
Recommended Actions	It is recommended that FHWA research and identify institutional issues involved in rural ATIS and methods to overcome those issues.
Expected Outcomes	· Identify additional issues that exist in rural ATIS. · Identify ways to overcome the institutional issues. · Develop a methodology to address future issues.
Cost	Low (<$ 150,000)
Risks	· Issues that are not completely addressed will have a negative impact on rural ATIS.
Responsibility **FHWA:**	· Develop methods to overcome existing barriers. · Document methods that could help to overcome future barriers.
Private Sector:	· Work with the public sector to overcome the barriers.

ADDITIONAL RESEARCH

There are three areas for which research is recommended that are applicable to all three rural ATIS focus areas. They are broader issues which affect any potential rural ATIS project.

- Determine Funding Sources for Rural ATIS - Funding is the primary issue for local agencies considering implementing an ATIS project. Sources and guidelines for attaining funding must be prepared for rural and small urban agencies unfamiliar with implementing a project of this type.

- Investigate Institutional Barriers to Implementation of Rural ATIS - There are obvious institutional barriers to rural ATIS projects, including competition for limited funds and reluctance to share or relinquish jurisdictional authority. These barriers must be identified, and methods to overcome them must be developed.

- Study System Architecture Issues in Rural ATIS - Determine the system requirements for collecting and aggregating data over a large geographical area. Investigate alternatives for communication and other system functions.

NEXT STEP

Up to this point, the project has produced a comprehensive study of user needs, an in-depth technology assessment, a series of preliminary rural ATIS concepts, and recommendations for future FHWA actions. Selected action items identified in this report will be carried out based on FHWA's priorities on each item.

APPENDIX A. PRELIMINARY CONCEPTS

This appendix presents a short description of the preliminary rural ATIS concepts developed in response to the user needs. Detailed descriptions of these concepts can be found in the "Preliminary Concepts Working Paper" prepared for the project.[3]

EMERGENCY RESPONSE

Cellular Mayday System

The cellular mayday system is an in-vehicle system which transmits an emergency "help" signal through the cellular telephone communication system to an emergency response center. The in-vehicle system has an on-board GPS location device to determine the vehicle's coordinates, which are transmitted as part of the mayday signal so that emergency response providers know the vehicle's exact location. The primary characteristic of this system is that the transmitted help signal is a synthesized voice, allowing any existing emergency response center, especially 911 services, to receive and understand the help signal with no need for special equipment.

Satellite Mayday System

The satellite mayday system is an in-vehicle system which transmits an emergency "help" signal through a low-earth-orbit (LEO) satellite communication system to an emergency response system. The in-vehicle system has an on-board GPS location device that determines the vehicle's coordinates, which are transmitted as part of the mayday signal so emergency response providers know the vehicle's exact location. The satellite mayday system is operable anywhere; worldwide satellite coverage is available. The satellite mayday system is also adaptable to two-way communication, so the travelers can receive an acknowledgement that help is en route.

Slow-Scan Video for Emergency Response

This emergency response concept uses slow scan video to record and transmit a visual record of the accident scene from on-site to a dispatch center, with forwarding to appropriate associated responder units. The video image communication is supplemented by voice communication to facilitate clear understanding and documentation of conditions.

First responder vehicles (law enforcement and ambulances) will be equipped with portable video cameras, one-way slow scan communication, and two-way audio communication to the agency dispatch/communication center. The video and audio records transmitted to the dispatch center will enable immediate assessment of conditions, including injuries, property damage, fire/explosion danger, hazardous material spills, etc., to aid in subsequent response agency alerts, actions, and victim trauma control steps.

CVO CB Samaritans

The CVO CB Samaritans concept is envisioned as a formal, cooperative program between the trucking industry and government agencies to enlist trucking firms and their drivers to report accidents, reckless driving, motorists needing assistance, and related road hazard and safety circumstances via CB radios. Institutional arrangements will be created to achieve broad support of State and national trucking associations, trucking fleets, and truck drivers to transmit CB radio emergency alerts to enforcement

patrols or other officials. The program will be mounted as a public service and highway safety initiative of the trucking industry and government.

The CVO CB Samaritan program leverages existing infrastructure to provide a low cost, manual data collection system for incident and safety notification in rural areas. Participating truck drivers will use existing CB radios to send emergency messages, which are normally monitored by State police patrol officers. Disabled vehicles, stranded travelers, accidents, other incidents, adverse weather and visibility conditions, safety hazard, emergency situations, and erratic or dangerous driving behavior are examples of the types of situations which might be reported.

SAFETY AND HAZARD WARNING

Slippery Conditions Warning System

The slippery conditions warning system uses ice detection technologies to determine when icy or slippery conditions exist on special segments of the roadway, such as bridge structures or low elevation pavements. The system then provides dynamic warning of those conditions to travelers. The dynamic warning attribute is a key feature of the concept, emphasizing its effectiveness over static warning signs which convey no "real-time" sense of conditions to travelers.

Electronic Flare Warning System

The electronic flare warning system is an in-vehicle device, envisioned for use on slow moving farm and construction equipment, which transmits warning signals or advisory information to surrounding or approaching vehicles by emitting a short range radio signal. The approaching vehicle has an on-board device that receives the transmitted signal and issues an appropriate warning signal to the driver. This concept could be adapted to many hazard situations, such as roadway incidents (emergency response vehicles could transmit the warning message) or roadway geometrics (standard hazard warning signs such as sharp curve or low clearance ahead would be equipped with stationary transmitters). The concept could also be applied to emergency vehicles.

Railroad Crossing Warning System

The railroad crossing warning system is an active device used to warn drivers of the presence of an oncoming train at unprotected grade railroad crossings. The system concept uses a transmitter on the approaching train to send a signal to vehicles approaching the grade crossing, providing the driver with positive notification that a train is approaching.

Extended Tail Light Warning System

The extended tail light concept will be made up of vehicle detectors and light sources mounted either above ground at the shoulder edge or embedded in the pavement. Passage of a vehicle will activate the lights and cause them to remain lit for a certain length of time, depending on the vehicle speed, grade, and road surface conditions. The illuminated lights will indicate the safe following distance.

Weather/Road Conditions Monitoring System Using Vehicle Probes

The weather and road condition monitoring system using vehicle probes is a concept which will take advantage of vehicles which regularly travel segments of rural roads. These vehicles, such as law enforcement and maintenance vehicles, will be used to probe the rural roadway network for weather

and road conditions. Data collection by these vehicle probes will be downloaded to roadside units, from which the data will be transmitted to travelers via CMS, roadside information systems, HAR, etc.

Vehicle-Based Adaptive Safe Speed System

This concept will present the driver with a recommended safe speed for given geometric conditions. The system uses information on vehicle weight, vehicle type, roadway geometry, and road surface conditions to recommend a safe speed. Static and dynamic roadway data will be combined with vehicle data in an on-board processor to compute the safe speed.

Roadside Safe Speed System

The roadside safe speed warning system will use information on vehicle characteristics, roadway geometry, and road surface condition to recommend a safe speed. This concept is similar to the vehicle-based adaptive safe speed warning system concept, with the exception that all components are on the roadside. Static and dynamic roadway data will be combined with detected vehicle characteristics at a roadside processor, and a safe speed will be presented to the driver on a roadside sign.

Animal Warning System

The animal warning system concept will emit a high frequency signal or signals, audible to animals but not humans, to alert animals and divert them away from the roadway. The goal of this concept is to warn animals which are large enough to cause an accident or damage a vehicle; however, it is likely that domestic animals will also be affected.

There are products available which claim to alert animals of approaching vehicles; however, their effectiveness is unknown. It is envisioned that the animal warning system concept will initially be more of a research effort into the applicability of existing products than a development effort of a new device. After the effectiveness of the concept on animals is determined, it will be further developed so that the device can be mounted on vehicles.

Winter Road Maintenance Management System

The winter road maintenance management system uses advanced roadway and weather data collection technology along with vehicle probe technologies. The system gathers detailed real-time roadway and weather condition information to guide effective scheduling of winter roadway maintenance operations. The primary purpose is to provide more pertinent and accurate data to road maintenance personnel than is currently available. With this data, maintenance personnel can more accurately and efficiently schedule and apply sand, deicing agents, and clearing resources. As a secondary but important benefit of the system, the information collected by the highway agencies could also be disseminated to travelers to assist them in making travel decisions.

Work Zone Delay Advisory System

The work zone delay advisory system concept provides travelers with an active indication that delays actually exist at the work zone. Three types of systems with varying levels of complexity could provide delay indication to travelers. The simplest system is a static sign with flashers which can be activated when there are delays. The second levels uses speed sensors to determine approximate delay through the work zone and changeable message signs to transmit the information to travelers. The

third level takes advantage of an automatic vehicle identification travel time monitoring system to more accurately determine delay at work zones.

CVO as Vehicle Probes

The CVO probe concept uses AVI-tagged commercial vehicles as data collection units to obtain travel time measurements between specific points along a roadway or network. The information product is quite limited (point-to-point travel time), but if enough observations are obtained, expected travel times can be defined. Deviations can then be used to signal possible incidents or unusual conditions. The data gathered from vehicles probes can be made available to travelers at rest areas, kiosks, or other outlets.

TRAVELER SERVICES INFORMATION

Pre-Trip Information System

The pre-trip information system concept uses existing communications technologies to provide easily accessible self-service dissemination of traveler service, routing, and advisory information. This concept is envisioned to address traveler needs during the pre-trip planning stage: trip routing, en route facilities, road conditions, weather conditions, travel time, traveler services, etc.

Read-Only Portable Tourist-Information System

The read-only portable tourist-information system can provide travel directions, information on lodging, dining, attractions, and motorist service on a route-specific or regional basis, in a format that the traveler can carry along and query as necessary. The system, possibly contained in a personal digital assistant, can be borrowed or rented at the trip origin (route specific data base) or at the destination (regional data base) and returned after the trip is complete. Regional systems could be developed for national parks and other major attractions, providing travelers with information about various points of interest within the area.

Roadside Information System (Kiosk)

The roadside information system concept uses existing kiosk information center technologies to provide easily accessible, self-service traveler advisory and service information. Using automated kiosks at roadside locations (rest areas, welcome centers, gas stations, etc.) or origin/intermediate trip points (auto travel clubs, commercial transportation terminals, hotels, etc.) to provide travel information addresses many of the en route non-emergency traveler needs identified in the user assessment task. These user needs include trip routing, en route facilities, road conditions, weather conditions, traveler services, alternate routes, and road closures.

Rural Navigation System

This concept will use real-time vehicle location, navigation, and a guidance system to provide specific route directions to user-selected destinations. The key elements of this concept are the abilities to determine vehicle location, to store sufficient map data base information, and to determine the most efficient path, all accomplished in-vehicle. The system could be rented from auto clubs or could be permanently installed in special vehicles, such as recreation vehicles or emergency service vehicles.

This is not a new idea; similar systems have been tested and used in many urban areas and are available commercially. The emphasis of this concept, though, is to provide navigation services in rural areas by development of rural data bases.

Low-Cost Route Diversion System

The low-cost route diversion system concept uses static guide signs and route markers to define permanent alternates to primary routes with recurrent congestion problems. The concept is modeled after a successful strategy used in the United Kingdom. One or more routes are predefined as alternates to heavily traveled tourist routes. Each alternate route is assigned a distinctly colored symbol identifier (e.g., triangle, square, circle, diamond). At a defined diversion point on the main route, travelers are given the option to divert and follow a specific alternate route, designated by the particular colored symbol identifier to a given destination. Frequent diversion confirmation is given along the route by placing colored symbols on existing static signs, and the end of the diversion route is also signed. Additional confirmation can be given by occasional distance guide signs noting the mileage to the diversion end or the destination.

In-Vehicle Information System

The in-vehicle information system concept uses an external communication infrastructure to provide in-vehicle traveler advisory and service information. As the vehicle proceeds along highways, roadside transmission units located at selected points (e.g., just before a small urban area or a major attraction) broadcast local area information, which the in-vehicle unit receives and stores for traveler use. Broadcasting information that is relevant only to the immediate local area is very useful for meeting traveler advisory and traveler services needs. It can provide very current information for such dynamic subjects as congestion, tourist attraction parking, and lodging availability. The system can also provide information on local area activities and services and may, optionally, include a map which shows the area covered by the current broadcast data base. The in-vehicle units could either be rented from auto clubs or car rental agencies or be permanently installed in vehicles as part of a comprehensive in-vehicle traveler information system.

Wide Area Traveler Information Center (TIC)

The concept of a wide area traveler information center is to provide a single, regional source for traveler information. The TIC will process, aggregate, and disseminate information regarding roadway and weather conditions, incidents, traveler services, and facilities. Information will be distributed to user interfaces within the region, such as HAR, CMS, personal communication devices, commercial radio, and kiosks. The TIC can serve as a distribution center directly to travelers if it is in an accessible location. A network of TIC's will cover adjacent regions so that a traveler may pass from one TIC's control area into another's without loss of service, similar to air traffic control.

Active Logo Signing System

The active logo signing concept uses simple, dynamic displays on standard roadside specific service (logo) signs to indicate the status of services (e.g., open/closed, vacancy/no vacancy). The user needs survey found that rural travelers unfamiliar with an area want to know not just what services are available at a specific location, but whether service stations and restaurant are open and if lodging and camping establishments have vacancies. The active logo signing concepts adds "open/closed" or "vacancy/no vacancy" lighted indicators to the specific service signs.

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